

NATIONAL WATER QUALITY NETWORK - SUPPLEMENT 2

Plankton Population Dynamics

from a study conducted JULY 1, 1959-JUNE 30, 1961

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RELATED PUBLICATIONS

National Water Quality Network
Annual Compilation of Data, October 1, 1957-September 30, 1958
Public Health Service Publication No. 663 (1958 Edition)

National Water Quality Network
Statistical Summary of Selected Data, October 1, 1957-September 30, 1958
Public Health Service Publication No. 663—Supplement 1

National Water Quality Network
Annual Compilation of Data, October 1, 1958-September 30, 1959
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FOREWORD

The chemical, physical and biological characteristics of surface waters are inter-related phenomena. Making greater use of the stream biota to determine existing, and to forecast future, water quality in the stream offers promising possibilities. Plankton studies within the National Water Quality Network have included extensive work designed to permit application of the principle of diatom species diversity to the development of water quality indices. The studies required development of new laboratory analytical techniques, as well as preliminary application of the methodology to surface water samples from the many diverse Network sampling points.

Published herein are data from samples collected in the 2-year period July 1959 through June 1961 at 65 of the Network stations. While this work is continuing within the Network program, it is hoped that the material here presented will enable workers in this field to evaluate the techniques described by applying them more broadly.



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Plankton Population Dynamics



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Charts of Sampling Stations

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ANIMAS RIVER		LAKE MICHIGAN		OHIO RIVER	
Cedar Hill, N. Mex.	26	Milwaukee, Wis.	46	Cairo, Ill.	69
APALACHICOLA RIVER		LAKE SUPERIOR		Evansville, Ind.	70
Chattahoochee, Fla.	27	Duluth, Minn.	47	Cincinnati, Ohio	71
ARKANSAS RIVER		LAKE SUPERIOR, ST. MARY'S RIVER		Huntington, W. Va.	72
Pendleton Ferry, Ark.	28	Sault Ste. Marie, Mich.	48	East Liverpool, Ohio	73
Ponca City, Okla.	29	HUDSON RIVER		POTOMAC RIVER	
Coolidge, Kans.	30	Paughkeepsie, N.Y.	49	Great Falls, Md.	74
CHATTAHOOCHEE RIVER		ILLINOIS RIVER		Williamsport, Md.	75
Columbus, Ga.	31	Peoria, Ill.	50	RED RIVER (NORTH)	
Atlanta, Ga.	32	KANAWHA RIVER		Grand Forks, N. Dak.	76
COLORADO RIVER		Winfield, W. Va.	51	RED RIVER (SOUTH)	
Yuma, Ariz.	33	KLAMATH RIVER		Alexandria, La.	77
Page, Ariz.	34	Keno, Oreg.	52	Index, Tex.	78
Loma, Colo.	35	LITTLE MIAMI RIVER		Denison, Tex.	79
COLUMBIA RIVER		Cincinnati, Ohio	53	RIO GRANDE RIVER	
Clatskanie, Oreg.	36	MISSISSIPPI RIVER		Brownsville, Tex.	80
Bonneville, Oreg.	37	E. St. Louis, Ill.	54	Laredo, Tex.	81
Pasco, Wash.	38	Burlington, Iowa	55	El Paso, Tex.	82
Wenatchee, Wash.	39	Dubuque, Iowa	56	ST. LAWRENCE RIVER	
DELAWARE RIVER		St. Paul, Minn.	57	Massena, N.Y.	83
Philadelphia, Pa.	40	New Orleans, La.	58	SAVANNAH RIVER	
Marlins Creek Pa.	41	Delta, La.	59	Port Wentworth, Ga.	84
GREAT LAKES		W. Memphis, Ark.	60	N. Augusta, S.C.	85
LAKE ERIE, NIAGARA RIVER		Cape Girardeau, Mo.	61	SCHUYLKILL RIVER	
Buffalo, N.Y.	42	MISSOURI RIVER		Philadelphia, Pa.	86
LAKE HURON, DETROIT RIVER		St. Louis, Mo.	62	SNAKE RIVER	
Detroit, Mich.	43	Kansas City, Kans.	63	Wawawai, Wash.	87
LAKE HURON, ST. CLAIR RIVER		St. Joseph, Mo.	64	Weiser, Idaho	88
Port Huron, Mich.	44	Omaha, Nebr.	65	TENNESSEE RIVER	
LAKE MICHIGAN		Yankton, S. Dak.	66	Chattanooga, Tenn.	89
Gary, Ind.	45	Bismarck, N. Dak.	67	YELLOWSTONE RIVER	
		Williston, N. Dak.	68	Sidney, Mont.	90

The National Water Quality Network

The Public Health Service program for providing fundamental information on the quality of the Nation's waters stems from Public Law 660, approved July 9, 1956, as amended by Public Law 87-88, July 20, 1961. Section 4(c) thereof states: ". . . the Secretary [of Health, Education, and Welfare] shall, in cooperation with other Federal, State, and local agencies having related responsibilities, collect and disseminate basic data on chemical, physical, and biological water quality insofar as such data or other information relate to water pollution and the prevention and control therof."

To fulfill this responsibility, the National Water Quality Network collects, interprets, and disseminates:

- a. Information on changes in water quality at key points in river systems, as such quality may be affected by changes in water use and development.
- b. Continuous information on the nature and extent of pollutants affecting water quality.
- c. Data which will be useful in the development of comprehensive water resources programs.
- d. Data which will assist State, interstate, and other agencies in their water pollution control programs, and in the selection of sites for legitimate water uses.

Some 50 sampling stations were established when the program started, October 1, 1957. By January 1, 1962, the number had grown to 102.

Each sampling location satisfied one or more of the following criteria:

- a. Major waterways used for public water supply, propagation of fish and wildlife, recreational purposes, and agricultural, industrial, and other legitimate uses.
- b. Interstate, coastal, and international boundary waters.
- c. Waters on which activities of the Federal Government may have an impact.

Sampling station sites are fixed only after consultation with local, State, Federal and other agencies having related interests.

Active local participation is important in this operation. It assures maximum development of all information valuable both locally and nationally. Program costs are shared by the Federal Government and State and local agencies, those of the latter through contributions of laboratory and sampling manpower. Specifically, the State and local agencies perform most of the conventional chemical analyses and collect samples for the newer, more complex examinations. The Public Health Service, in turn, performs the more complex determinations and makes the results available to the participants. In addition, the consultation, training facilities, and other resources of the Public Health Service are available to the cooperating agencies.

Locations of sampling stations in operation as of January 1, 1962, are shown on page 3. Descriptions of the stations, participating agencies, and other pertinent information are presented on pages 5-8.

Only after careful screening of needs in water resource development was a pattern set for analyses of water samples. All Network samplings are examined for:

- a. Radioactivity.
 - (1) Gross alpha.
 - (2) Gross beta
 - (3) Strontium 90
- b. Plankton populations.
- c. Coliform organisms.
- d. Organic chemicals
- e. Biochemical, chemical, and physical measurements, including biochemical oxygen demand (B.O.D.), dissolved oxygen (D.O.), chemical oxygen demand (C.O.D.), chlorine demand, ammonia nitrogen, hydrogen ion concentration (pH), color turbidity, temperature, alkalinity (or acidity), hardness, chloride, sulfate, phosphates, and total dissolved solids.
- f. Trace elements.

Samples for groups a, c, and e are collected and analyzed weekly. Samples for organic chemicals are collected monthly, while the schedule for plankton organism examinations is semimonthly. Strontium 90 analyses are made on composites of weekly samples accumulated over a 3-month period. Trace elements are determined

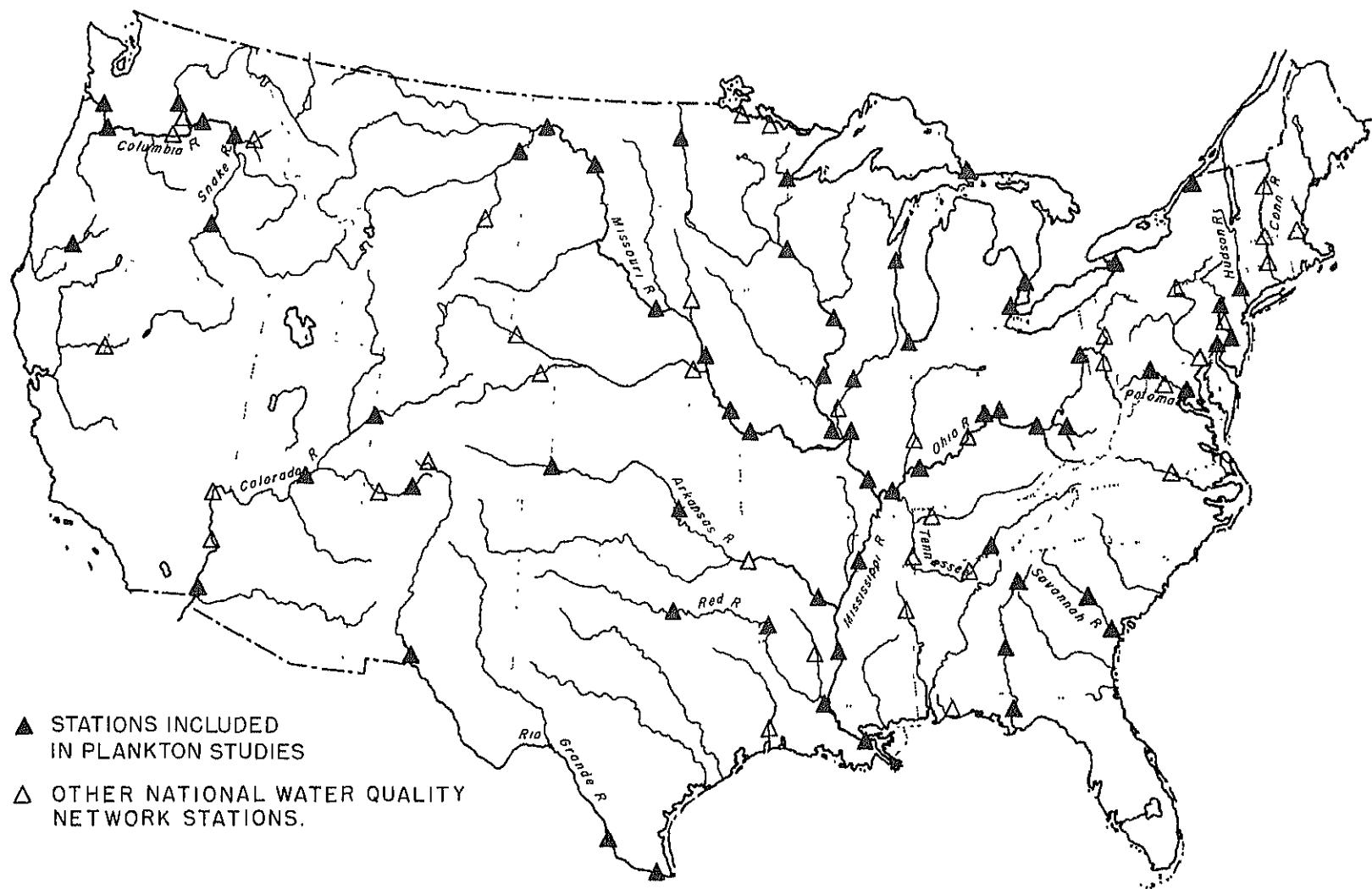
on 2-month composites of weekly samples. New parameters which are developed and found significant are included as the program continues.

Water Quality Parameters

In the assessment of water quality, all of the legitimate purposes for which raw waters can be used, and which may be affected by pollution, must be considered. These may range from the minimum requirements necessary for navigation to the ultimate in water quality demanded for special industrial processing. Quality needs differ considerably, therefore, according to water use.

For domestic use water must be free of disease organisms, clear, colorless, taste- and odor-free, and must have a relatively low dissolved mineral content. Agricultural water is judged primarily on its mineral content, especially with respect to the ratio between sodium and other cations, and the presence of boron. Water for fish propagation and recreational purposes must be relatively free from domestic and industrial pollution and must be able to sustain an active flora of the smaller aquatic organisms on which fish and wildlife feed. Industrial water quality demands run the gamut from the complete absence of minerals to a requirement of low temperature, the critical factor in water used for cooling. The effects of radioactive materials on these uses have not yet been fully appraised.

National Water Quality Network Sampling Stations



Introduction to the Plankton Studies

Although many water quality and water pollution studies have been made of rivers, there has been relatively little investigation of plankton in relation to water quality. This supplemental report presents information on the plankton populations found at 65 selected stations of the National Water Quality Network. Findings reported are based upon semimonthly samplings over a 2-year period ending June 30, 1961.

Plankton are composed of algae and other plant and animal organisms, and they do have an important relationship to the quality of the water in which they live. Always present in lakes and streams, these minute organisms are vital to water's self purification process. They take up and concentrate radionuclides from the water and when the cells die, they release radionuclides in the water.

Plankton also provide food for fish and other aquatic life. They sometimes cause taste and odor problems in water supplies. They may hinder water treatment by clogging filters. Often they become so abundant as to cause a nuisance in recreational areas and deplete oxygen in the water during decomposition. Because they exhibit population dynamics, plankton can serve as important indicators of water quality. For example, pollutants in the water may alter drastically the normal population patterns of plankton—an effect which may be observed through plankton population studies.

The data herein documented will be especially valuable because

identification and enumeration of the organisms were given uniform treatment, making comparisons relevant. Most other studies deal only with the larger net plankton and are not year-round studies.

In 1957 when the Network program was inaugurated, 16 sampling stations were in use on a monthly basis. At this time all diatoms including empty shells were included in the total counts. By 1959 the sampling schedule became semimonthly and the inert diatom shells were counted, separated and excluded from the total phytoplankton counts. The clump count procedure is used to tally the plankton organisms per ml. This includes all of the preservable algae larger than bacteria. In this method each single cell and natural clump or colony is recognized as a unit. From these data one may use a factor to determine other standard units.

All plankton which can be recognized in the preserved samples are being identified. These include fungi, sheathed bacteria, protozoa, crustaceans, rotifers, nematodes, and other invertebrates. Although these represent a small segment of the total population, their presence is noted for possible future use in studies of their relationship to water quality.

Much of the emphasis in the plankton program has been on diatoms. Both in total population and number of species they constitute the largest planktonic group in the rivers and Great Lakes. They are important indicators of water quality and its variations.

SAMPLING STATIONS AND COOPERATING AGENCIES

STATION	MILES ABOVE MOUTH	DESCRIPTION	SAMPLED BY	OTHER COOPERATING AGENCIES
ANIMAS RIVER above Cedar Hill, N. Mex.	33	Heizer Ranch at natural gas pipeline crossing.	San Juan County Health Dept.	New Mexico Dept. of Public Health
APALACHICOLA RIVER at Chattahoochee, Fla.	105	Jim Woodruff Dam Powerhouse	U.S. Army Corps of Engineers Florida State Hospital, Chattahoochee, Florida.	Florida State Board of Health
ARKANSAS RIVER at Pendleton Ferry, Ark. at Ponca City, Okla. at Coolidge, Kans.	45 646 1,099	Ferry Landing, South Shore Old U.S. Highway No. 60 Bridge (formerly at Osage Station, Okla. Gas and Electric Co.) U.S. Geological Survey Stream Gaging Station	Arkansas State Water Pollution Control Commission Ponca City Water Dept. U.S. Geological Survey	Arkansas State Board of Health Oklahoma State Dept. of Health Kansas State Board of Health Colorado State Dept. of Health
CHATTAHOOCHEE RIVER at Columbus Ga. at Atlanta, Ga.	160 303	Columbus Water Dept. Plant Intake Atlanta Water Dept. Plant Intake	Columbus Water Dept. Atlanta Water Dept.	Georgia State Dept. of Public Health Georgia State Dept. of Public Health
COLORADO RIVER at Yuma, Ariz. at Page, Ariz. near Loma, Colo.	91 775 1,150	Arizona Water Co. Intake Page Water Plant Intake Pumping Station at E.R. Smith Farm	Arizona Water Co. U.S. Bureau of Reclamation Mesa County (Colorado) Dept. of Public Health	Arizona State Dept. of Health Arizona State Dept. of Health Utah State Dept. of Health Colorado State Dept. of Public Health
COLUMBIA RIVER near Clatskanie, Oreg. at Bonneville Dam, Wash., Oreg. at Pasco, Wash. at Wenatchee, Wash.	53 145 327 465	Beaver Army Terminal U.S. Army Transp., Supply and Maintenance Command Bonneville Dam Powerhouse Municipal Water Plant Intake Plant Intake, Aluminum Co. of America	U.S. Army U.S. Public Health Service U.S. Army Corps of Engineers Pasco Water Dept. Aluminum Co. of America Chelan-Douglas County Health Dept.	Oregon State Sanitary Authority Washington State Dept. of Health Washington State Pollution Control Commission Washington State Dept. of Health Washington State Pollution Control Commission Washington State Dept. of Health Washington State Pollution Control Commission

SAMPLING STATIONS AND COOPERATING AGENCIES—Continued

STATION	MILES ABOVE MOUTH	DESCRIPTION	SAMPLED BY	OTHER COOPERATING AGENCIES
DEL AWARE RIVER at Philadelphia, Pa.	110	Municipal Water Plant Intake (Toresdale Plant)	Philadelphia Water Dept.	Pennsylvania State Dept. of Health
at Martins Creek, Pa.	191	at Martins Creek Steam Electric Station	Pennsylvania Power and Light Co	Pennsylvania State Dept. of Health
GREAT LAKES	—	Municipal Water Plant Intake	Buffalo Water Dept.	New York State Dept. of Health
Lake Erie, Niagara River at Buffalo, N.Y.	—	Erie County (N.Y.) Health Dept.	Michigan State Dept. of Health	
Lake Huron, Detroit River at Detroit, Mich.	29	Municipal Water Plant Intake (Water Works Park)	Detroit Board of Water Commissioners	Michigan State Water Resources Commission
Lake Huron St. Clair River at Port Huron, Mich	38	Municipal Water Plant Intake	City of Port Huron, Michigan	Michigan State Dept. of Health
Lake Michigan at Gary, Ind	—	Gary-Hobart Water Corp. Intake	Gary-Hobart Water Corp.	International Joint Commission
Lake Michigan at Milwaukee, Wis.	—	Municipal Water Plant Intake	City of Milwaukee, Wisconsin	Michigan State Water Resources Board
Lake Superior at Duluth, Minn	—	Municipal Water Plant Intake	Duluth Water, Gas and Sewage Treatment Dept.	Indiana State Board of Health
Lake Superior, St. Mary's River at Sault Ste. Marie, Mich.	48	Municipal Water Plant Intake	Sault Ste. Marie Water Dept.	Wisconsin State Board of Health
HUDSON RIVER below Poughkeepsie, N.Y.	70 (est)	International Business Machine Corp. Plant Intake	International Business Machine Corp.	Minnesota State Dept. of Health
ILLINOIS RIVER at Peoria, Ill.	166	Peoria Water Works Co. Plant Intake	Peoria Water Works Co.	Michigan State Dept. of Health
KANAWHA RIVER at Winfield Dam, W. Va.	30	Winfield Dam Power Plant	West Virginia Water Resources Commission	New York State Dept. of Health
KLAMATH RIVER at Keno, Oreg.	220	one mile below Copco Hydro-generating Plant	City of Klamath Falls	Kanawha Valley Power Company
LITTLE MIAMI RIVER at Cincinnati, Ohio	2	Robert A. Taft Sanitary Engineering Center Raw Water Intake	Klamath County Health Dept.	West Virginia State Dept. of Health
MISSISSIPPI RIVER at East St. Louis, Ill.	1,166	East St. Louis Water Co. Intake	Public Health Service	California-Oregon Power Company
at Burlington, Iowa	1,369	Municipal Water Plant Intake		City of Cincinnati, Ohio
at Dubuque, Iowa	1,549	U.S. Army Corps of Engineers Lock and Dam #11		Illinois State Dept. of Public Health
at Lock and Dam #3 below St. Paul, Minn.	1,757	U.S. Army Corps of Engineers Lock and Dam #3	Burlington Water Dept.	Iowa State Dept. of Health
			Dubuque Water Dept.	Iowa State Dept. of Health
				Minnesota State Dept. of Health
				Minneapolis-St. Paul Sanitary District

SAMPLING STATIONS AND COOPERATING AGENCIES—Continued

STATION	MILES ABOVE MOUTH	DESCRIPTION	SAMPLED BY	OTHER COOPERATING AGENCIES
at New Orleans, La.	105	Municipal Water Plant Intake	New Orleans Sewage and Water Board	Louisiana State Dept. of Health
at Delta, La. (formerly at Vicksburg, Miss.)	433	River Landing, Delta Casting Yard, U.S. Corps of Engineers	Mississippi State Board of Health	Louisiana State Dept. of Health
at West Memphis, Ark.	726	Barge Terminal, Oklahoma-Mississippi River Products Lines, Inc.	Memphis (Tennessee) Light, Gas and Water Division	Arkansas State Board of Health
at Cape Girardeau, Mo.	1,020	Missouri Utilities Co. Water Intake	Missouri Utilities Co.	Tennessee State Dept. of Public Health
MISSOURI RIVER				Missouri State Dept. of Public Health and Welfare
at St. Louis, Mo.	36	Water Plant Intake, St. Louis County Water Co. and Howard Bend Plant, City of St. Louis	St. Louis County Water Dept. St. Louis Water Dept.	Missouri State Dept. of Public Health and Welfare
at Kansas City, Kans.	385	Municipal Water Plant Intake	Kansas City (Kansas) Board of Public Utilities	Kansas State Board of Health
at St. Joseph, Mo.	471	St. Joseph Water Co. Intake	St. Joseph Water Co.	Missouri State Dept. of Public Health and Welfare
at Omaha, Nebr.	642	Metropolitan Utilities Dist. Water Plant Intake	Metropolitan Utilities District	Nebraska State Dept. of Health
at Yankton, S. Dak.	841	Municipal Water Plant Intake	Yankton Water Dept.	South Dakota State Board of Health
at Bismarck, N. Dak.	1,377	Municipal Water Plant Intake	Bismarck Water Dept.	North Dakota State Dept. of Health
at Williston, N. Dak.	1,644	Municipal Water Plant Intake	Williston Water Dept.	
OHIO RIVER				
at Cairo, Ill.	3	Cairo Water Co. Intake	Cairo Water Co.	Illinois State Dept. of Public Health
at Evansville, Ind.	190	Municipal Water Plant Intake	Evansville Water Dept.	Indiana State Board of Health
at Cincinnati, Ohio	518	Municipal Water Plant Intake	Cincinnati Water Dept.	Ohio State Dept. of Health
at Huntington, W. Va.	677	Huntington Water Co. Intake	Huntington Water Corp.	West Virginia State Dept. of Health
at East Liverpool, Ohio	941	Municipal Water Plant Intake	East Liverpool Water Dept.	Ohio State Dept. of Health
POTOMAC RIVER				
at Great Falls, Md.	126	Washington, D.C. Water Plant Intake	U.S. Army Corps of Engineers	Maryland State Dept. of Health
at Williamsport, Md.	212	Hagerstown Municipal Water Plant Intake	Hagerstown Water Dept.	Maryland State Dept. of Health
RED RIVER (North)				
at Grand Forks, N. Dak.	296	Municipal Water Plant Intake	Grand Forks City Water Dept.	North Dakota State Dept. of Health
RED RIVER (South)				
at Alexandria, La.	122	Pumping Station on Levee near City Wells	Alexandria Water Dept.	Louisiana State Dept. of Health
at Index, Ark.	485	U.S. Highway No. 71 Bridge	Texarkana Water and Sewer Systems Arkansas State Water Pollution	Arkansas State Board of Health

SAMPLING STATIONS AND COOPERATING AGENCIES—Continued

STATION	MILES ABOVE MOUTH	DESCRIPTION	SAMPLED BY	OTHER COOPERATING AGENCIES
RIO GRANDE at Brownsville, Tex.	40	Brownsville Filtration Plant Plant #1 Intake	Brownsville Water Dept.	Texas State Dept. of Health
at Laredo, Tex.	356	Municipal Water Plant Intake	Laredo Water Dept.	Texas State Dept. of Health
at El Paso, Tex.	1,234	Municipal Water Plant Intake	El Paso Public Service Board	Texas State Dept. of Health
ST. LAWRENCE RIVER at Massena, N.Y.	492	Aluminum Foundry Plant Intake	Chevrolet Motor Div., General Motors Corp., Aluminum Foundry	New York State Dept. of Health
SAVANNAH RIVER at Port Wentworth, Ga.	22	State Highway No. 17 Bridge	Union Bag-Camp Paper Co., U.S. Army Corps of Engineers Chatham County Health Dept. North Augusta Water Dept.	Georgia State Dept. of Public Health
at North Augusta, S.C.	217	Municipal Water Plant Intake	North Augusta Water Dept.	South Carolina State Dept. of Health
SCHUYLKILL RIVER at Philadelphia, Pa.	10	Municipal Water Plant Intake	Philadelphia Water Dept.	Pennsylvania State Dept. of Health
SNAKE RIVER at Wawawai, Wash.	111 (est)	Pumping Station at I. E. Wilson Farm	Washington State College	Washington State Dept. of Health
at Weiser, Idaho	354	Municipal Water Plant Intake	Weiser Water Dept.	Idaho State Board of Health
TENNESSEE RIVER at Chattanooga, Tenn.	467 (est)	City Water Company Intake	City Water Company of Chattanooga	Tennessee State Dept. of Public Health
YELLOWSTONE RIVER at Sidney, Mont.	30	Intake-Lewis and Clark Station Montana-Dakota Utilities Co.	Montana-Dakota Utilities Co.	Montana State Board of Health

Equipment, Materials and Methods

Samples of raw water are collected semimonthly from each Network station and sent for processing to the Public Health Service's Water Quality Laboratory, Cincinnati, Ohio. Each sample is taken directly from the river or lake, or from a continuously flowing intake (as at a water treatment plant) receiving the river or lake water.

The sample, consisting of three liters of untreated water, is added to 100 ml. of preservative (thimerosal, 0.16 percent, plus Lugol's solution, 1 percent) in a polyethylene sample bottle. The Lugol's solution stains parts of the cells making identification easier. It also aids in settling the plankton since the iodine causes some of them to lose gas and, therefore, their buoyancy. This preservative has been found to be effective for approximately 1 month during the warm seasons and longer during cool weather. One gram of sodium borate is added for each gram of thimerosal to help keep the thimerosal in solution.

Three analyses, each requiring one liter, are performed per sample: (1) the genera of phytoplankters are identified and enumerated using the Sedgwick-Rafter slide technique; (2) the genera of microinvertebrates, mostly rotifers and crustaceans, are settled, identified to genus and counted in a special microslide; and (3) the diatoms are settled, washed and made into a permanent hyrax slide from which are made proportional counts of the species and some of the varieties. These determinations are also used to qualitative to genus the diatoms recorded in the Sedgwick-Rafter (step one) procedure and to make the proportional counts in step three.

Phytoplankters counted in the Sedgwick-Rafter slide include forms, measuring four microns or more. Clump counts are made

of fungi and sheathed bacteria. The Sedgwick-Rafter counts for total algae that were alive when collected are made as clump counts in which each single-celled individual or natural clump or colony of cells is enumerated as one. Diatom shells without chromatophores are tallied separately from preserved diatoms with chromatophores.

Because tiny centric and pennate diatoms cannot be adequately identified to genus from the Sedgwick-Rafter slide, their determination is dependent on accurate identification during proportional counting from permanent hyrax slides. However, all other algae are determined to genus, including the colonial diatoms *Melosira*, *Asterionella*, *Fragilaria* and *Tabellaria*. These diatoms form natural aggregates or colonies and can be recognized in a Sedgwick-Rafter cell. All other diatoms, however, are counted only as centrics or pennates since identification, even to genus, is often obscure with the resolution and magnification (200X) available in the Sedgwick-Rafter method. The identification and relative abundance of various diatom species are determined from a permanent hyrax slide and these findings are used to identify the genera of the diatoms in each Sedgwick-Rafter count.

In concentrating by centrifugation of raw samples low in phytoplankton a moderate proportion of buoyant forms is lost, broken apart or so compacted with their spines or gelatinous secretions that they cannot be redistributed randomly for counting under the microscope. For these reasons most of the quantitation of phytoplankters has been obtained from unconcentrated or undiluted raw water samples. The count is in a Sedgwick-Rafter slide using 20-power objectives and 10-power oculars, and is accomplished by

counting two lengthwise strips (about 500 microns) the width of the Whipple square.

These two strips represent a volume of about 0.05 ml. To obtain the number of plankters per ml., a factor of 20 to 22 is used, varying with the correction for preservative dilution and differences in calibration of the microscopes. Precise techniques have been developed for obtaining representative and geometrically accurate one-ml. samples for counting in the Sedgwick-Rafter slide.

For the rare occasions where concentrations of phytoplankton were necessary, settling proved to be the best method, affording the least loss or distortion of organisms. Furthermore, this concentration technique has the advantage of allowing the sediment to be washed with distilled water to free it of colloidal material and some of the silt particles, which interfere with optics in some of the turbid samples.

Identification of diatom species and their proportional census is done from incinerated frustules of diatoms settled and washed from a liter of sample. The washed sediment containing the diatoms is dried on a warming table on a number one coverglass, and this sediment is ashed in place on the coverslip on a red-hot hotplate. This method does not appear to change the minute identification markings of the siliceous cell walls and enables the two valves (epitheca and hypotheca), as well as the groups of cells attached to one another, to remain in a natural grouping, so that Sedgwick-Rafter counts and proportional counts can be matched.

Chemical cleaning was abandoned because bubbling separates the valves, distorts natural cell grouping, and tends to inflate the actual count. Permanent slide mounts are made with hyrax medium. The technique of settling, washing in distilled water, and mounting does not appear to alter the uniformity of the diatom species composition. Proportional counts are made with 90-power oil immersion apochromatic objectives and 10-power oculars containing a Whipple micrometer grid. Random strip counts are made until the total number of units reaches 200 to 300. Higher counts are necessary when one or two species are overwhelmingly abundant.

Identification to species is facilitated by the described techniques

in settling, washing and hyrax preparation, and by the use of the best optical lenses available.

Proportional counting of diatoms from permanent slides is on a modified unit-area basis, in which each single cell or each portion of a natural aggregate occupying up to 300 square microns is tallied as one unit, cells or aggregates occupying from 300 to 1,000 square microns as two, those 1,000 to 2,500 square microns as three, those 2,500 to 5,000 square microns as four, and those over 5,000 square microns as five. The Whipple grid makes this scaling simple. This system gives a slight weighting to the larger specimens and colonies, which are seldom numerically abundant, but it is basically the same as the Sedgwick-Rafter count used for enumerating the other phytoplankters. About 95 percent of the cells or clumps naturally fall into size class one or two.

Proportional Counting

The numbers and kinds of diatoms obtained from the one-liter sample aliquot usually provide sufficient organisms for a kinds-to-numbers determination. This involves identifying and counting enough diatoms of the four most abundant species and the remainder. For this analysis, counting of great numbers was found unnecessary; the percentages of the total diatom count are determined for the four most numerous species after counting only about 250 or so individuals. Further counting does not significantly change the proportion of the total population thus found to be represented by the four predominant species.

This more rapid method of determining the species diversity by using diatoms was developed because of the large number of samples processed from the National Water Quality Network. A trained counter requires about 45 minutes to read an average slide.

Some generalizations about community dynamics are possible because a separate tally is maintained for each species. The diatom charts (pages 15 and 16), showing the relative occurrence of the four species most abundant at 65 stations, dramatically show the distribution and species character of the Network.

Biotic Characterization of Waterways

The organisms most abundant at any sampling station at any given time are the most reliable key to conditions of the environment. Species present in relatively lower numbers may not be reliable for this purpose because they sometimes represent organisms washed into the stream from ponds, creeks and other minor aquatic habitats. Furthermore, the flowing together of two unlike principal streams may produce a segment of mixing water containing organisms that do not represent true environmental conditions. Surviving healthy organisms become reliable indicators when they continue to multiply in the new water mixture and become predominant.

The four most abundant diatom species reflect in most situations the environmental conditions in the streams and Great Lakes. They were used during this investigation to indicate differences in water quality and other environmental conditions. Rare organisms are frequently encountered in streams that receive biota from other streams or lakes with unlike environments. Relatively dense, healthy plankton populations of several species, however, are very useful, because they usually represent favorable environmental conditions.

In analyzing the plankton from the same rivers and lakes for over three years, one is impressed with the "personality" of each river and many of its stations, based on the kinds of dominant biota each supports. The person engaged in plankton identification and enumeration soon learns to recognize many of the rivers and even individual stations by the characteristic plankton each produces. The table on page 13, wherein letters are used to show the presence

of individual species, reveals the similarities among stations on a given stream. For example, similarities are noted between the stations of the Great Lakes and between those of the Columbia River. Also, the Southeast, the Northeast, the Southwest, and the upper and lower Mississippi River each have their characteristic diatom floras.

A decided marine influence at three of the Network stations is evidenced by the brackish diatoms always present. These are Poughkeepsie, New York on the Hudson River; Port Wentworth, Georgia on the Savannah River; and Philadelphia, Pennsylvania on the Delaware River. In addition, the diatoms of Port Wentworth include species typical of the South Atlantic coastal waters.

Some other coastal stations have shown marine influence after periods of low rainfall, which allows brackish water to back up during periods of high tide. *Cyclotella striata* is the most common species from these stations, but brackish species of *Coscinodiscus denarius* are also numerous.

Diatoms found in large numbers in all major drainage basins and the Great Lakes are *Diatoma vulgare*, *Fragilaria crotonensis*, *Melosira ambigua*, *Melosira granulata*, and *Stephanodiscus hantzschii*.

Diatoms characteristic of the Great Lakes (absent or extremely rare at river stations) are *Cyclotella comta*, *Cyclotella kutzningiana*, *Melosira binderana*, *Melosira islandica* and *Rhizosolenia eriense*.

Diatoms characteristic of the Arkansas, Colorado and Rio Grande rivers (arid regions with waters of high calcium carbonate hardness and often with high dissolved salts) are *Amphiprora alata*, *Amphiprora paludosa*, *Amphora ovalis*, *Biddulphia laevis*, *Caloneis amphisbaena*,

Pleurosigma delicatula, *Surirella brightwellii* and *Surirella striatula*. In the Red River (south) *Diploneis smithii* dominate.

Certain diatoms dominate for short periods at widely separated stations, but are characteristic for these stations by their abundance and high fidelity. The Southeast is represented by *Cyclotella pseudostelligera* and *Melosira distans* variety *alpigena*. Buffalo, New York and Peoria, Illinois are identified by the high incidence of *Stephanodiscus niagarae*. While *Tabellaria fenestrata* is widely distributed, it overwhelmingly dominates at Gary, Indiana.

In the Ohio River, except East Liverpool, Ohio, two species of *Melosira* are abundant: *M. ambigua* and *M. granulata*. A large centric diatom *Stephanodiscus niagarae* variety *magnifica* is characteristic of the Klamath River. The Colorado, Snake and Yellowstone rivers often have fossil species of diatoms.

The stations with the highest counts (productivity) are Peoria, Illinois; Ponca City, Oklahoma; St. Paul, Minnesota; Keno, Oregon and Grand Forks, North Dakota.

While Gary, Indiana has the highest productivity of the Great Lakes stations, its counts are low when compared with those of high productive river stations. In general the lowest production stations are on the Great Lakes and in the Southeast.

Most of the 65 stations represented in this report have their highest counts during February–May. Only 13 of the 65 had their highest counts during October–January.

High temperatures and impounded water promote dense populations of blue-green algae in the late summer and early fall at several stations such as Cincinnati on the Ohio River.

Heavy turbidity drastically reduces the planktonic biota, particularly evident in the lower Missouri river.

Achnanthes minutissima, reported by ecologists to be an indicator of high dissolved oxygen, is common in the headwaters of the Columbia River.

Asterionella formosa and *Diatoma elongatum* become abundant during cold water seasons.

Distribution of Most Abundant Species of Diatoms

Stations

RIVERS	1 kPN	2 kdP	3 PVm	4 mPA	5	6	7	8
ne	ZAW	kdL						
de	kLY							
re	Chj	kXL	kXL					
he	Qdf	bhD	Bxg					
th)	MIZ	IcP	FEB					
ri	IMQ	MIc	MIc					
es	QdI	QkT	QTr	dTI	IVd			
	Okd	Odb	Oda	dcI	cdL	DLe	LKD	
	QdT	QdI	QdT	Qdc	dQI	IQT	QdT	dIQ
	TQJ							
	dWL	ALG						
	SKH	SQY						
	dQe							
	NeR	PdU	PmO	Umx	Pmd	mPA	mQR	

Key to Species

A	<i>Achnanthes minutissima</i>
B	<i>Amphiprora paludosa</i>
C	<i>Anomooneis exilis</i>
D	<i>Asterionella formosa</i>
E	<i>Biddulphia laevis</i>
F	<i>Caloneis amphisbaena</i>
G	<i>Coccconeis placentula</i>
H	<i>Coscinodiscus denarius</i>
I	<i>Cyclotella meneghiniana</i>
J	<i>Cyclotella striata</i>
K	<i>Cymatosira beligica</i>
L	<i>Diatoma vulgare</i>
M	<i>Diploneis smithii</i>
N	<i>Fragilaria capucina</i>
O	<i>Fragilaria construens</i>
P	<i>Fragilaria crotontensis</i>
Q	<i>Melosira ambigua</i>
R	<i>Melosira binderana</i>
S	<i>Melosira distans alpigena</i>
T	<i>Melosira granulata</i>
U	<i>Melosira islandica</i>
V	<i>Melosira varians</i>
W	<i>Navicula cryptocephala</i>
X	<i>Navicula viridula</i>
Y	<i>Navicula</i> sp.
Z	<i>Nitzschia lanceolate</i> group
a	<i>Nitzschia linearis</i>
b	<i>Nitzschia palea</i> type
c	<i>Stephanodiscus astraea minutula</i>
d	<i>Stephanodiscus hantzschii</i>
e	<i>Stephanodiscus niagarae</i>
f	<i>Surirella brightwellii</i>
g	<i>Surirella ovata</i>
h	<i>Surirella striatula</i>
i	<i>Synedra acus</i>
j	<i>Synedra tabulata</i>
k	<i>Synedra ulna</i>
l	<i>Synedra vaucheriae</i>
m	<i>Tabellaria fenestrata</i>
x	Other entity

These are the three species occurring most frequently in the one year period ending June 1 at each of the plankton study stations in 15 Network waterways (including the Great Lakes as a single unit). This three-species identification affords a simple, quick comparison of the important diatoms and demonstrates the distinct "personalities" of the sampling stations. Each three-letter symbol represents a station and the stations (except the Great Lakes) are read in upstream sequence beginning at the river mouth.

Diatom Species Occurring at the Study Stations*

October 1959–June 1961

Achnanthes lanceolata Bréb.
Achnanthes minutissima Kütz.
Amphipora alata Kütz.
Amphipora paludosa W. Smith
Amphora ovalis Kütz.
Anomoeoneis exilis (Kütz.) Cleve
Asterionella formosa Hassall
Bacillaria paradoxa Gmelin
Biddulphia laevis Ehr.
Caloneis amphibiaena (Bory) Cleve
Ceratoneis arcus Kütz.
Cocconeis pediculus Ehr.
Cocconeis placentula Ehr.
Coscinodiscus rothii (Ehr.) Grun.
Cyclotella atomus Hust.
Cyclotella comta (Ehr.) Kütz.
Cyclotella glomerata Bachm.
Cyclotella kutzningiana Thwaites
Cyclotella meneghiniana Kütz.
Cyclotella pseudostelligera Hust.
Cyclotella stelligera Cl. & Grun.
Cyclotella striata (Kg.) Grun.
Cymatopleura solea (Bréb.) W. Smith
Cymatotira beligica Grunow
Cymbella affinis Kütz
Cymbella tumida (Bréb.) Heurck
Cymbella ventricosa Kütz.
Diatoma anceps (Ehr.) Grunow
Diatoma elongatum C. A. Agardh
Diatoma vulgare Bory
Diploneis smithii (Bréb.) Cleve
Epithemia turgida (Ehr.) Kütz.
Epithemia sorex Kütz.
Eunotia pectinalis (Kütz.) Raben.

Fragilaria brevistriata Grun.
Fragilaria capucina Desm.
Fragilaria construens (E.) Grun.
Fragilaria cratonensis Kitton
Fragilaria leptostauron (Ehr.) Hust.
Fragilaria pinnata Ehr.
Fragilaria virens Ralfs.
Frustulia vulgaris Thwaites
Gomphonensis herculeana (Ehr.) Cleve
Gomphonema olivaceum (Lyngb.) C. Ag.
Gomphonema parvulum Kütz.
Gyrosigma kutzningii (Grun.) Cleve
Hantzschia amphioxys (Ehr.) Grun.
Melosira ambigua (Grun.) O. Müller
Melosira binderana Kg.
Melosira distans (Ehr.) Kütz.
var. *alpigena* Grun.
Melosira granulata (Ehr.) Ralfs.
Melosira islandica O. Müller
Melosira varians C. A. Agardh
Meridion circulare (Grev.) C. A. Ag.
Navicula canalis Patrick
Navicula contenta Grun.
Navicula cryptocephala Kütz.
Navicula cuspidata Kütz.
Navicula hungarica Grun.
Navicula mutica Kütz.
Navicula notha Wallace
Navicula tripunktata (Mull.) Bory
Navicula viridula Kütz.
Nitzschia acicularis (Kütz.) W. Smith
Nitzschia apiculata (Gregory) Grun.
Nitzschia denticula Grun.
Nitzschia dissipata (Kütz.) Grun.

Nitzschia filliformis (W. Smith) Hust.
Nitzschia fonticola Grun.
Nitzschia holsatica Hust.
Nitzschia hungarica Grun.
Nitzschia linearis W. Smith
Nitzschia parvula Levis
Nitzschia sigma (Kütz.) W. Smith
Nitzschia sigma (Kütz.) W. Smith
Nitzschia tryblionella Hantzsch
Pinnularia borealis Ehr.
Pleurosigma delicatulum W. Smith
Rhoicosphenia curvata (Kütz.) Grun.
Rhizosolenia eriensis H. L. Smith
Rhopalodia gibba (Ehr.) O. Müller
Stephanodiscus astraea (Ehr.) Grun.
var. *minutula* (Kütz.) Grun.
Stephanodiscus dubius (Fricke) Hust.
Stephanodiscus hantzschii Grun.
Stephanodiscus niagarae Ehr.
Stephanodiscus niagarae Ehr.
var. *magnifica* Fricke
Stephanodiscus tenuis Hust.
Surirella angustata Kütz.
Surirella brightwellii W. Smith
Surirella ovata Kütz.
Surirella striatula Turpin
Synedra acus Kütz.
Synedra pulchella Kütz.
Synedra nana Meister
Synedra tabulata (C. Ag.) Kütz.
Synedra ulna (Nitzsch.) Ehr.
Synedra vaucheriae Kütz.
Tabellaria fenestrata (Lyngb.) Kütz.
Tabellaria flocculosa (Roth) Kütz.

* Each species listed occurred one or more times in aggregate samplings as one of the four most abundant recorded at study stations in the 15 waterways involved.

Occurrence of Four Most Abundant Diatom Species

OCURRENCE AS ONE OF THE FOUR
MOST ABUNDANT SPECIES OF DIATOMS

- - 1 to 25 PERCENT OF THE TIME
- △ - 26 to 50 PERCENT OF THE TIME
- ▲ - 51 to 75 PERCENT OF THE TIME
- - 76 to 100 PERCENT OF THE TIME

RIVER STATION

ANIMAS CEDAR HILL
ATAPALACHICOLA CHATTAHOOCHEE

ARKANSAS PINEDELTON FERRY
FONCA CITY
COOLIDGE

CHATTAHOOCHEE COLUMBUS
ATLANTA

COLORADO YUCA
PAGE
LOMA

COLUMBIA CLATSASKIE
BONNEVILLE
PASCO
TENATCHEE

DELAWARE PHILADELPHIA
MARTINS CREEK

GREAT LAKES BUFFALO
MILWAUKEE
DETROIT
DULUTH
GARY
SAULT STE. MARIE
PORT HURON

HUDSON PUGHKEE PSIF
ILLINOIS PEORIA

KANAWHA WINFIELD
KLAZAH KENO

LITTLE MIAMI CINCINNATI
MISSISSIPPI E. ST. LOUIS

(upper) BURLINGTON
DUGUARD
ST. PAUL
NEW ORLEANS

(lower) DELTA
WEST MEMPHIS
CAPE GIRARDEAU

MISSOURI ST. LOUIS
KANSAS CITY
ST. JOSEPH
OMAHA
YANKTON
BISMARCK
WILLISTON

OHIO CAIRO
EVANSVILLE
CINCINNATI
HUNTINGTON
EAST LIVERPOOL

POTOMAC GREAT FALLS
WILLIAMSPORT

RFD (North) GRAND FORKS

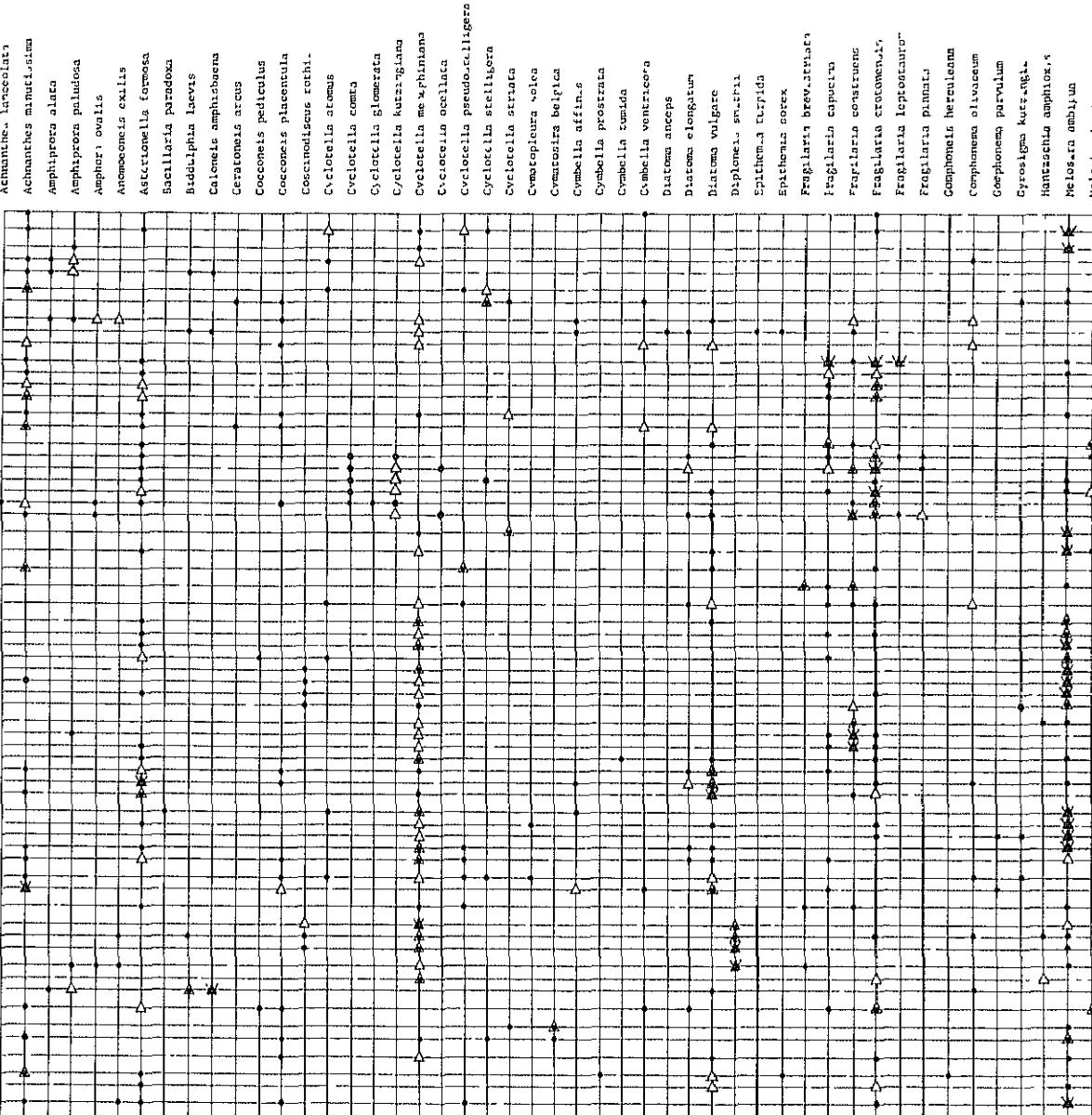
RFD (South) ALEXANDRIA
INDYX
DENISON

RIO GRANDE BROWNSVILLE
LAREDO
EI PASO

ST. LAWRENCE MASSNA
SAVANNAH PORT WENTWORTH
NORTH AUGUSTA

SCHUYLKILL PHILADELPHIA
WAWAHAWI
WIFSHR

TENNESSEE CHATTANOOGA
Y. LLOWNSTON SIDNEY



Occurrence of Four Most Abundant Diatom Species (continued)

WE STEELED OUT OF THE FOREST
AS IT IS A FOREST OF DIABOLI

- - 1 to 23 REPORT OF THE TIME
- 26 to 30 REPORT OF THE TIME
- - 31 to 25 REPORT OF THE TIME
- - 26 to 14 REPORT OF THE TIME

RESULTS

AMHRA, U.S. & HILL
SPLATHEMELLA FESTUCA
M. (11-15) 100-1000

EUROPEAN CITY
COUNCILS

6.1.1

124 - 125
P. D. LILLE
P. D. LILLE
P. D. LILLE

THE GREAT
LAKES

11111111
11111111
11111111
11111111

4-3
PUPA
LARVA
EGG

לְלִבְנֵי יִשְׂרָאֵל
בְּנֵי יִשְׂרָאֵל
בְּנֵי יִשְׂרָאֵל

(Upper) LT P T G I O V
 L D U G E
 LT P H I
(Lower) V - F X L P A V S
 L C L T A

W-1715413
Ltr 61-2-11

6.11

467 (467) 467 (467)

PITCHER: B. J. VILLE
L. J. J.
E. E. CO.
ST. L. A. N.Y.
H. J. L.

W. H. ST. POINT WOODBORTH
C. G. MILLER
C. G. MILLER
PHILADELPHIA

WILSON
WEISBERG
WILSON
WEISSMAN

Legend (Species listed from top to bottom):

- Phlebia ciliata* (pink diamond)
- M. effulens* (yellow diamond)
- M. subtilis* (yellow diamond)
- M. subtilis* *ambiguum* (yellow diamond)
- Melobius italicus* (yellow diamond)
- M. variolosus* (yellow diamond)
- Meridion circulare* (yellow diamond)
- Navicula canaliculata* (yellow diamond)
- Navicula cryptoccephala* (yellow diamond)
- Navicula cupidata* (yellow diamond)
- Navicula incognita* (yellow diamond)
- Navicula notata* (yellow diamond)
- Navicula triplinotata* (yellow diamond)
- Navicula virgulata* (yellow diamond)
- Nitzschia aciculata* (yellow diamond)
- Nitzschia apiculata* (yellow diamond)
- Nitzschia denticula* (yellow diamond)
- Nitzschia ovalis* *ovalis* (yellow diamond)
- Nitzschia fonticola* (yellow diamond)
- Nitzschia holterica* (yellow diamond)
- Nitzschia hungarica* (yellow diamond)
- Nitzschia linearis* (yellow diamond)
- Nitzschia sigma* (yellow diamond)
- Nitzschia sigmoides* (yellow diamond)
- Nitzschia trichoneura* (yellow diamond)
- Plasmularia borealis* (yellow diamond)
- Pleurosigma delicatulum* (yellow diamond)
- Rhizoplectena curvata* (yellow diamond)
- Rhizoplectena eriensis* (yellow diamond)
- Rhopalodia gibba* (yellow diamond)
- S. astraea* *mantaria* (yellow diamond)
- Stephanodiscus dubius* (yellow diamond)
- Stephanodiscus hantzschii* (yellow diamond)
- Stephanodiscus nitagae* (yellow diamond)
- S. ningaruae* var. *magnifica* (yellow diamond)
- Stephanodiscus tenellus* (yellow diamond)
- Sutirella angustata* (yellow diamond)
- Sutirella brightwellii* (yellow diamond)
- Sutirella crenata* (yellow diamond)
- Sutirella striatula* (yellow diamond)
- Synedra acuta* (yellow diamond)
- Synedra pulchella* (yellow diamond)
- Synedra rana* (yellow diamond)
- Synedra tabulata* (yellow diamond)
- Synedra ulna* (yellow diamond)
- S. medra vanheusdenae* (yellow diamond)
- Tabellaria ferrestrata* (yellow diamond)

Green Flagellates at 48 Stations

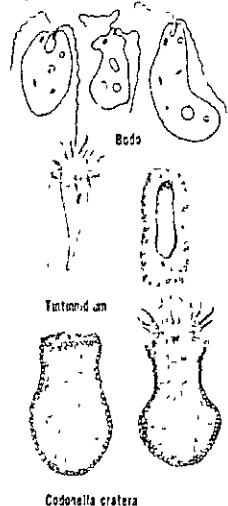
Because of the interest of some researchers in the use of green flagellate algae as potential indicators of organic enrichment, the compilation below is presented.

Semimonthly samples were used, beginning with the second sample in July 1960 through September 1961. Only those stations having uninterrupted sampling for this period are included. Average green flagellate counts for 48 stations for the 15-month period are shown below.

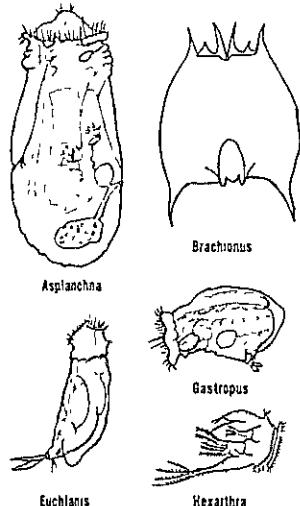
River	Station	Counts/ ml	River	Station	Counts/ ml
Missouri.....	Yankton, S. Dak.....	2,050	Mississippi.....	Delta, La.....	80
Mississippi.....	Minneapolis, Minn.....	481	Animas.....	Cedar Hill, N. Mex.....	72
Arkansas.....	Ponca City, Okla.....	466	Mississippi.....	W. Memphis, Ark.....	69
Ohio.....	E. Liverpool, Ohio.....	417	Colorado.....	Loma, Colo.....	67
Missouri.....	Omaha, Nebr.....	375	Arkansas.....	Pendleton Ferry, Ark.....	57
Chattahoochee.....	Columbus, Ohio.....	258	Hudson.....	Poughkeepsie, N.Y.....	51
Ohio.....	Evansville, Ind.....	252	Delaware.....	Martins Creek, Pa.....	51
Missouri.....	St. Joseph, Mo.....	226	Tennessee.....	Chattanooga, Tenn.....	51
Rio Grande.....	Brownsville, Tex.....	211	Red River (S).....	Denison, Tex.....	46
Ohio.....	Cincinnati, Ohio.....	196	Colorado.....	Yuma, Ariz.....	40
Missouri.....	Kansas City, Kans.....	176	Arkansas.....	Coolidge, Kans.....	37
Kanawha.....	Winfield, W. Va.....	167	Missouri.....	Bismarck, N. Dak.....	37
Yellowstone.....	Sidney, Mont.....	164	Colorado.....	Parker Dam, Ariz.-Calif.....	36
Missouri.....	St. Louis, Mo.....	162	Columbia.....	Bonneville, Oreg.....	35
Red River (S).....	Index, Tex.....	145	Columbia.....	Clatskanie, Oreg.....	33
Potomac.....	Great Falls, Md.....	139	Mississippi.....	New Orleans, La.....	31
Snake.....	Wawawai, Wash.....	138	Ohio.....	Cairo, Ill.....	29
Apalachicola.....	Chattahoochee, Fla.....	137	Lake Michigan.....	Gary, Ind.....	18
Colorado.....	Page, Ariz.....	134	Lake Erie.....	Buffalo, N.Y.....	15
Ohio.....	Huntington, W. Va.....	116	Lake Huron.....	Port Huron, Mich.....	12
Missouri.....	Williston, N. Dak.....	112	Lake Huron.....	Detroit, Mich.....	10
Mississippi.....	Dubuque, Iowa.....	89	Lake Superior.....	Duluth, Minn.....	3
Savannah.....	Port Wentworth, Ga.....	83	Lake Superior.....	Sault Ste. Marie, Mich.....	2
Mississippi.....	Cape Girardeau, Mo.....	82	Colorado.....	Boulder City, Nev.....	2

MICROINVERTEBRATES

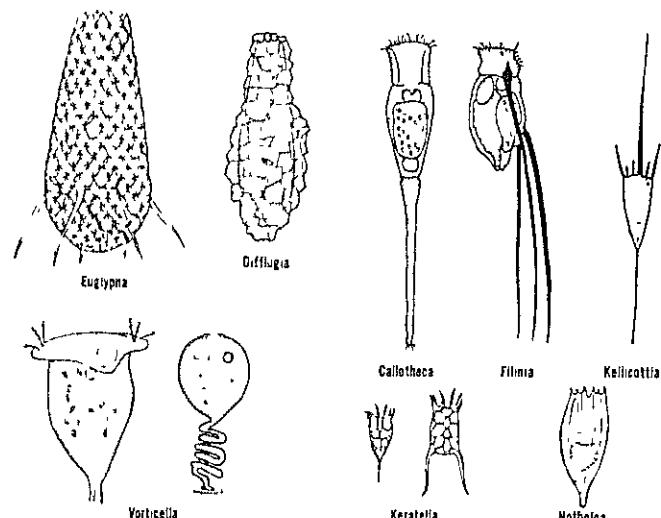
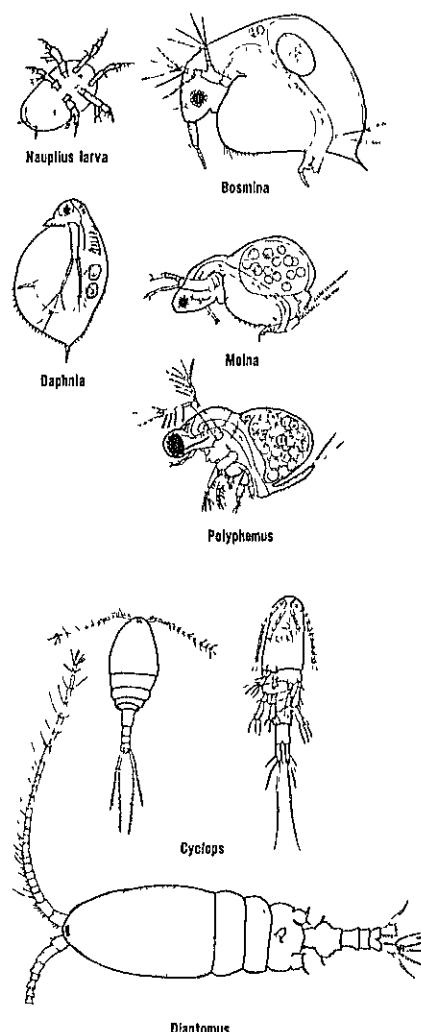
1-PROTOZOA



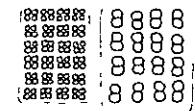
2-ROTIFERS



3-CRUSTACEA



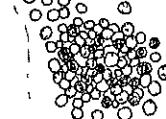
1-BLUE-GREEN ALGAE



Agmenellum (Merismopodium)



Anabaena



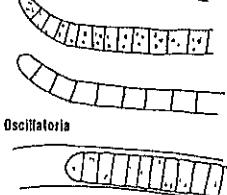
Anacyclis (Microcystis)



Aphanizomenon

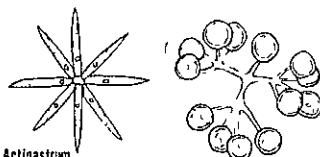


Oscillatoria



Phormidium

2-GREEN ALGAE



Actinastrum



Ankistrodesmus



Chlarcoccum



Cladophora



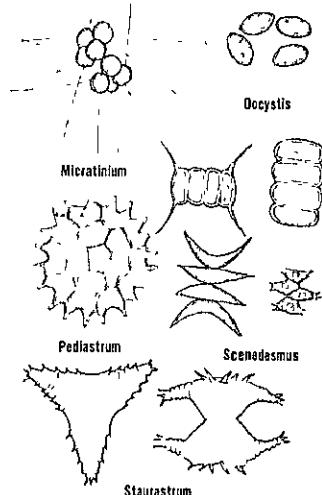
Dictyosphaerium



Golenkinia



Lagerheimia (Chodatella)



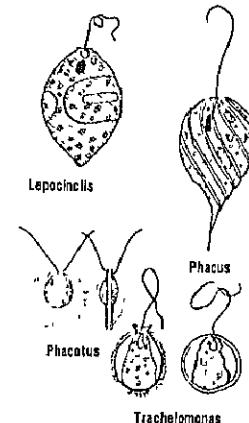
Oocystis

Micratinium

Pediatrum

Scenedesmus

Staurastrum



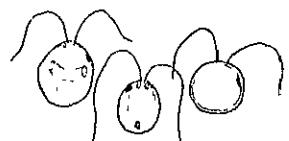
Lepocinella

Phacus

Phacotus

Trachelomonas

3-GREEN FLAGELLATES



Chlamydomonas



Closterium



Cosmarium

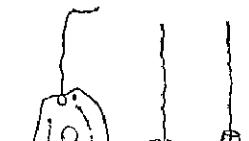


Crucigenia

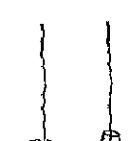


Euglena

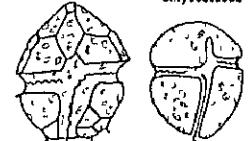
4-OTHER PIGMENTED FLAGELLATES



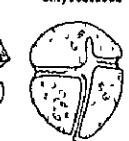
Chromulina



Chrysococcus



Diaphanidium



Ochromonas

DIATOMS

CENTRIC



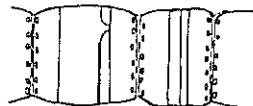
Cyclotella meneghiniana



Cyclotella stelligera



Cyclotella kutzningiana



Melosira binderiana

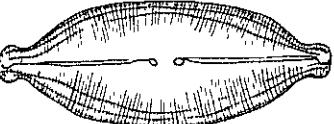


Melosira varians

PENNATE



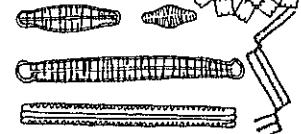
Achnanthus minutissima



Caloneis amphibiaena



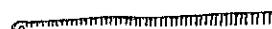
Cymbella tumida



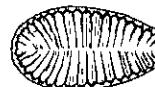
Diatoma vulgare



Diploneis smithii



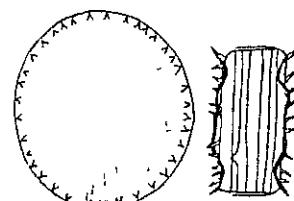
Synedra ulna



Surirella ovata



Gomphonema olivaceum



Stephanodiscus astraeanus



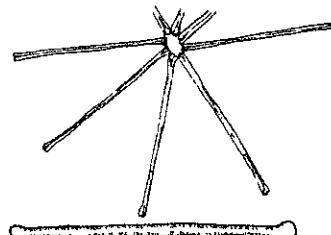
Stephanodiscus hantzschii



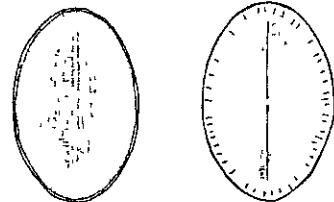
Melosira ambigua



Melosira granulata



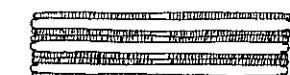
Asterionella formosa



Cocconeis placentula



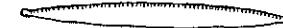
Fragilaria crotonensis



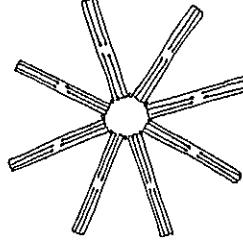
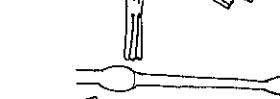
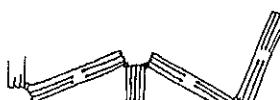
Fragilaria capucina



Navicula gracilis

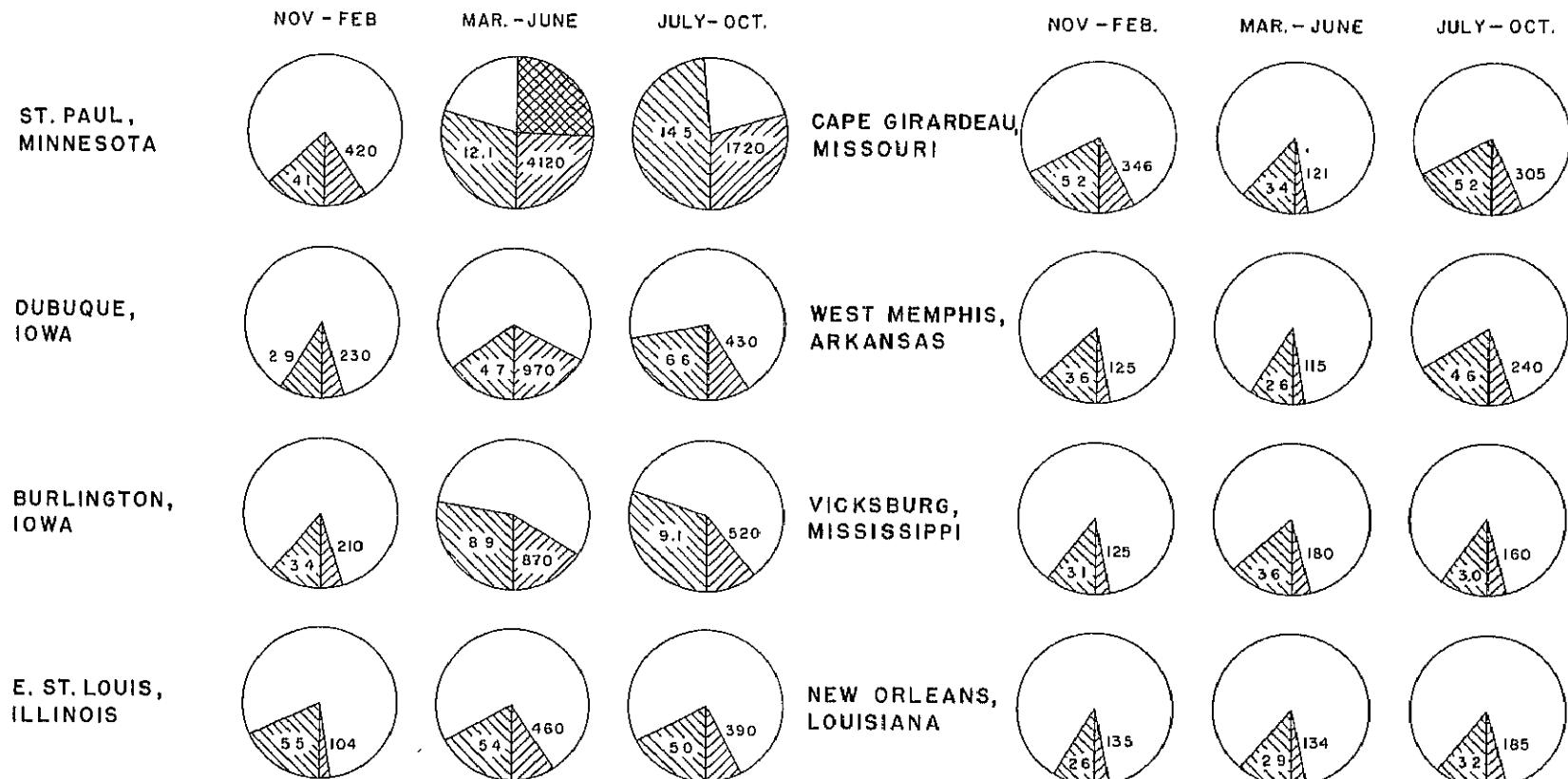


Nitzschia palea



Tabellaria fenestrata

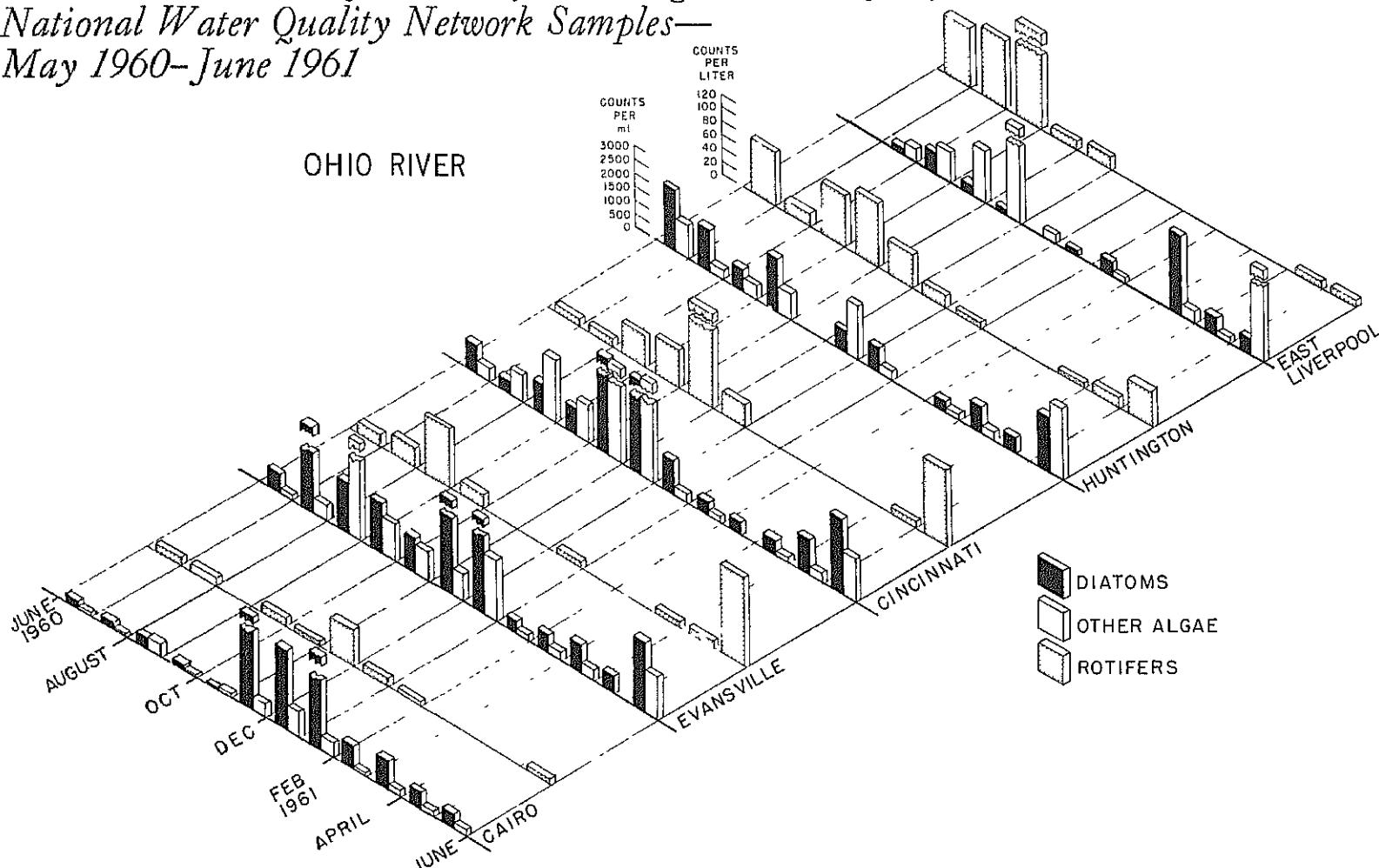
Planktonic Green Algae, Mississippi River—1959



LEGEND:  AVERAGE NO. GENERA / ml  AVERAGE COUNT / ml  AVERAGE COUNT / ml OVERLAP

Similarities or differences between sampling stations can be observed through separate reporting of the three major groups, diatoms, green flagellates, and rotifers. Charted above are planktonic green algae (nonflagellates) 4-month averages for the year 1959 at eight Mississippi River stations. The count decreases successively station by station downstream from St. Paul, Minn. to New Orleans, La. The average count per ml. for the whole year was 2,087 at St. Paul and 151 at New Orleans.

*Relative Abundance of Diatoms, Other Algae and Rotifers, Ohio River
 National Water Quality Network Samples—
 May 1960–June 1961*



Production by planktonic algae and consumption by planktonic rotifers has an important bearing on water quality. Wastes discharged into rivers may produce problems from overproduction by diatoms and other algae and underconsumption by microinvertebrates as the natural self-purification process takes place. To maintain water of high quality a balance of production and consumption is a desirable objective of stream management. A graphical presentation of this relationship for 5 sampling stations on the Ohio River is shown. Along the Ohio River the highest standing crops were observed during the late summer and early fall when flow rates are the lowest. Cincinnati, the midpoint station between the headwaters and river mouth, had the highest productivity of the 5 sampling stations.

Average Number of Rotifers Per Liter*

July 1960 through June 1961

River	Station	Count	River	Station	Count
Animas	Cedar Hill, N. Mex.	14.7	Mississippi (Lower)	New Orleans, La.	0.5
Apalachicola	Chattahoochee, Fla.	34.2		Delta, La.	0.8
Arkansas	Pendleton Ferry, Ark.	11.9		W. Memphis, Ark.	3.7
	Ponca, City, Okla.	39.0		Cape Girardeau, Mo.	2.8
Chattahoochee	Coolidge, Kans.	4.5	Missouri	St. Louis, Mo.	0
	Columbus, Ga.	125.2		Kansas City, Kans.	0
Colorado	Atlanta, Ga.	3.4		St. Joseph, Mo.	0.1
	Yuma, Ariz.	2.0		Omaha, Nebr.	0.5
	Page, Ariz.	2.0		Yankton, S. Dak.	27.3
Columbia	Loma, Colo.	0.6		Bismarck, N. Dak.	4.8
	Clatskanie, Oreg.	46.8		Williston, N. Dak.	0.9
	Bonneville Dam, Wash.-Oreg.	18.9	Ohio	Cairo, Ill.	3.0
	Pasco, Wash.	3.9		Evansville, Ind.	71.0
	Wenatchee, Wash.	3.7		Cincinnati, Ohio	58.0
Delaware	Philadelphia, Pa.	9.0		Huntington, W. Va.	28.0
	Martins Creek, Pa.	6.3	Potomac	E. Liverpool, Ohio	13.0
Great Lakes	Buffalo, N.Y.	66.1		Great Falls, Md.	2.9
	Detroit, Mich.	16.2		Williamsport, Md.	1.4
	Port Huron, Mich.	22.2	Red (No.)	Grand Forks, N. Dak.	175.9
	Gary, Ind.	16.2	Red (So.)	Alexandria, La.	48.8
	Milwaukee, Wis.	8.3		Index, Tex.	8.0
	Duluth, Minn.	1.3	Rio Grande	Denison, Tex.	6.0
	Sault Ste. Marie, Mich.	7.7		Brownsville, Tex.	137.2
Hudson	Poughkeepsie, N.Y.	8.0		Laredo, Tex.	0.1
Illinois	Peoria, Ill.	242.2	St. Lawrence	El Paso, Tex.	2.1
Kanawha	Winfield, W. Va.	6.1		Massena, N.Y.	16.0
Klamath	Keno, Oreg.	161.3	Savannah	Port Wentworth, Ga.	1.0
Little Miami	Cincinnati, Ohio	85.2		N. Augusta, S.C.	2.0
Mississippi (Upper)	E. St. Louis, Ill.	45.0	Schuylkill	Philadelphia, Pa.	13.0
	Burlington, Iowa	18.0	Snake	Wawawai, Wash.	4.7
	Dubuque, Iowa	42.0		Weiser, Idaho	18.8
	St. Paul, Minn.	242.0	Tennessee	Chattanooga, Tenn.	22.5
				Sidney, Mont.	0.8

*Semimonthly samples from 65 Stations of the National Water Quality Network.

Explanation Of Sampling Station Charts

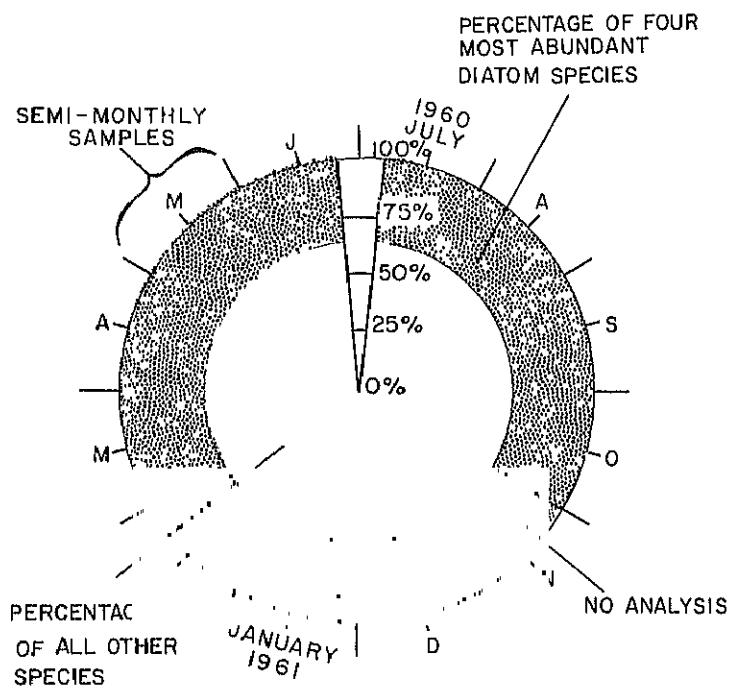
A. BAR GRAPH—Percent Occurrence and Relative Abundance of Diatoms.

The quality of surface waters at a given time may be indicated by the kinds and numbers of organisms they support. One effect of enrichment is a decrease in the diversity of the diatom species. The identification and relative abundance of the predominant diatom species is basic to the determination of their species diversity.

The bar graph, "Diatoms—Present Occurrence," lists those species of diatoms which appeared first, second, third or fourth in abundance in semimonthly samples taken during the period designated at 65 stations of the National Water Quality Network for the year beginning July 1, 1960. For those species in first or second place at any time, the graph presents the percent of the time they occurred as either first, second, third or fourth in abundance. For instance, in the Columbia River at Clatskanie, Oregon, *Synedra ulna* was the number one species 19 percent of the time, was in first or second place 32 percent of the time, was among the first three predominant species 51 percent of the time, and was among the first four 76 percent of the time. Species which never occurred in first or second place, but which did occur in third or fourth are listed, but their percent occurrence is not shown.

The percent occurrence in no way reflects the actual population density. A species second in abundance, for example, may be present in only small numbers; another may have occurred in large numbers in some samples, but because it was not among the first four, would not be listed.

Both the bar and circle graphs (see B, p. 25) deal with the same



DIATOMS COUNTS / ml.	CIRCLE SIZE
0-1000	SMALL
1001-3000	MEDIUM
3001-OR OVER	LARGE

sampling period. The bar graph includes species names and comprises one year's collection of data.

B. CIRCLE GRAPH—Diatoms, Species Diversity (See diagram at left).

While the bar graph is designed to show the percent occurrence and names of the four most abundant species for a year, the circle graph indicates the species diversity of diatoms at each of the 24 (semimonthly) sampling times for the year July 1960 through June 1961. Semimonthly samples are represented by radial lines extending from the perimeter of the circle. The short radial lines with month designations represent the second semimonthly samples normally taken during the third week of the month. The longer lines represent the first of the semimonthly samples. The months are recorded consecutively clockwise.

A total diatom population range is expressed in the size of the circle. Three circle sizes are used. A small circle (4 cm. in diameter) represents a diatom count of between zero and 1,000 per ml., a medium circle (6 cm. in diameter), between 1,001 and 3,000 per ml., and a large circle (8 cm.) above 3,001.

A total diatom population of any sample is represented as a percent by the radius designated for that sample. The percent of diatoms, other than the four most abundant species in a population, is determined by the distance from the center of the circle to a point on the radius. A quartile scale is given on a vertical radius of each circle. The central blank portion of the circle is formed by radially plotting percent of diatoms other than the four most abundant species. Sections shaded by the smaller dots represent samples not analyzed. Species diversity is indicated by the extension of the white area from the center of circle. Thus a line drawn to connect these points on the 24 radii inscribes a figure or pattern which may be characteristic for each station. As the central clear area extends outward greater species diversity is indicated. Correspondingly, less diversity is indicated as the outer dark area increases.

The perimeter is divided into evenly spaced sampling times and each circle graph shows the fluctuations in species diversity between

the 24 sampling times during the year. For example, species diversity is relatively great at Wawawai, Washington on the Snake River and relatively low at Grand Forks, North Dakota on the Red River. Many of the 65 circle graphs suggest seasonal patterns, with the least species diversity in late summer and fall. At Clatskanie, Oregon on the Columbia River, species diversity is greater during the winter months than the summer months.

C. LOGARITHMIC LINE GRAPH—Total Live Phytoplankton Counts.

Total live phytoplankton counts are plotted beginning with July 1959 for those stations that were in operation at that time. Counts are presented in a logarithmic scale on the vertical axis. The counts exclude the inert diatom shells. A summary of average seasonal total live phytoplankton counts is also presented. Seasonal periods averaged extend from June-September, October-January, and February-May.

D. TABLE OF ZOOPLANKTON

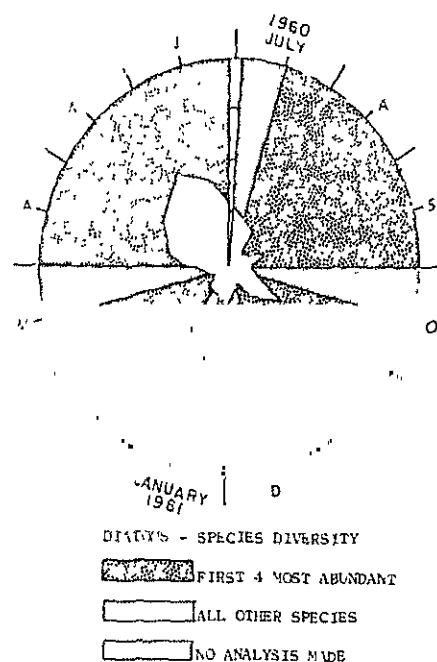
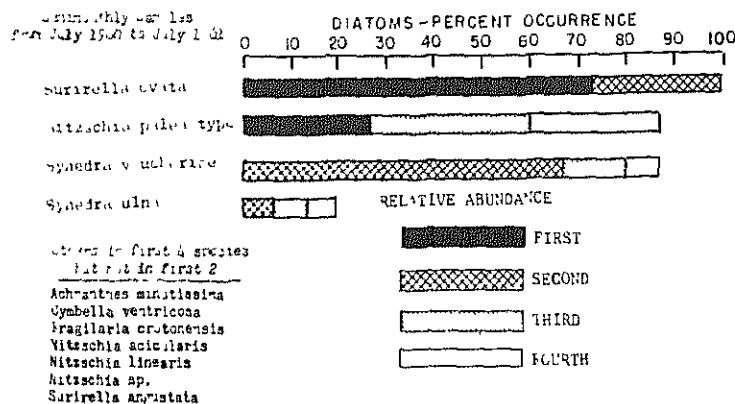
Four genera of rotifers were found to be very common in the major waterways of the United States by this study. The occurrence of these genera during the period July 1960 to July 1961 is presented with average counts per liter per sample. Column one presents the number of occurrences of all rotifers present in all samples. The second column gives the average count per liter based on all samples, whether or not rotifers were present.

Similar treatment is given copepods, cladocerans, nauplii, nematodes and other invertebrate metazoans.

E. TABLE OF MOST ABUNDANT GENERA OF ALGAE

The most abundant genera of algae are recorded in tabular form, the criterion for inclusion being occurrence in numbers 150 per ml. or more. The percent occurrence in these numbers is presented. The table is broken down into major groups (blue-greens, greens, green flagellates, other pigmented flagellates, diatoms—centric and pennate). This permits comparisons among these major groups of algae.

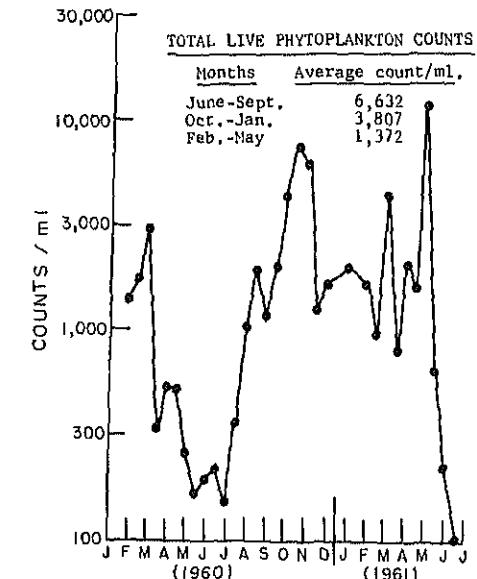
ANIMAS RIVER
CEDAR HILL, NEW MEXICO



ZOOPLANKTON

Samples analyzed 19
July 1960 to July 1961

Samples with Animals	Average count per liter per sample
Rotifers	14.7
Keratella	0.3
Polyarthra	0.1
Brachionus	0.1
Synchaeta	0
Other genera	14.2
Cladocerans:	
nauplii	0.1
copepods	0
cladocerans	0
Nematodes	0
Other invertebrate metazoans	0



MOST ABUNDANT GENERA OF ALGAE

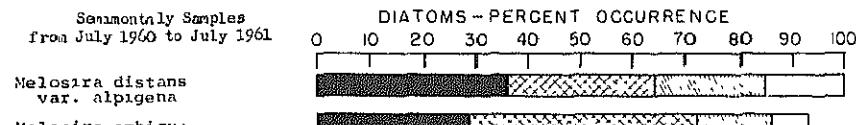
Percent frequency of counts 150 per ml. or more
From Feb. 1960 to May 1961

Diatoms

Pennate	
Achnanthes	14
Fragilaria	14
Gomphonema	7
Navicula	17
Nitzschia	35
Surirella	60
Synedra	71

APALACHICOLA RIVER
CHATTahoochee, FLORIDA

Seasonally Samples
from July 1960 to July 1961



Melosira distans
var. *alpigena*

Melosira ambigua

Stephanodiscus hantzschii

Cyclotella atomus

Cyclotella pseudostelligera

Cyclotella meneghiniana

Others in first 4 species
but not in first 2

Cyclotella stelligera

Fragilaria crenulata

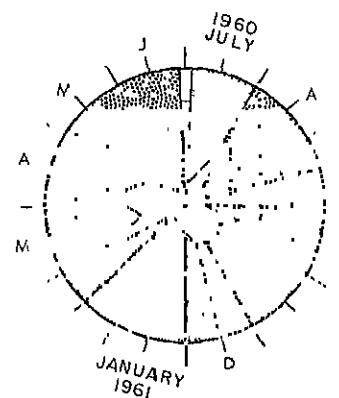
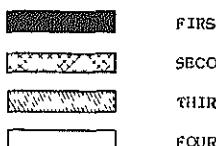
Melosira granulata

Velosira italica

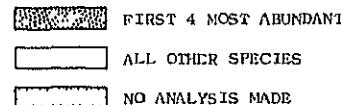
Nitzschia palea type

Synedra ulna

RELATIVE ABUNDANCE



DIATOMS - SPECIES DIVERSITY



ZOOPLANKTON

Samples analyzed 18

Aug. 1960 to July 1961

Samples with Animals	Average count per liter per sample
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Rotifers:	17	34.2
Keratella	16	10.7
Polyarthra	13	8.3
Brachionus	4	0.8
Synchaeta	8	2.4
Other genera	14	13.6

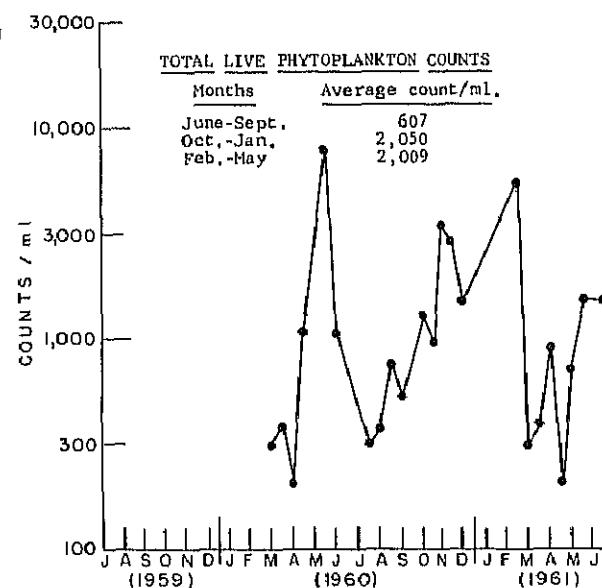
Crustaceans.		
nauplii	3	0.4
copepods	1	0.1
cladocerans	3	0.2
Nematodes		1.0
Other invertebrate metazoans	0	

MOST ABUNDANT

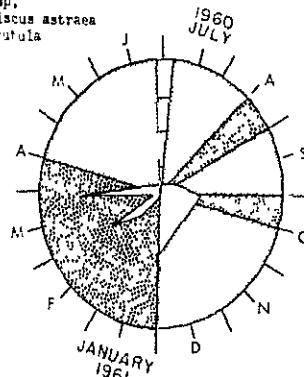
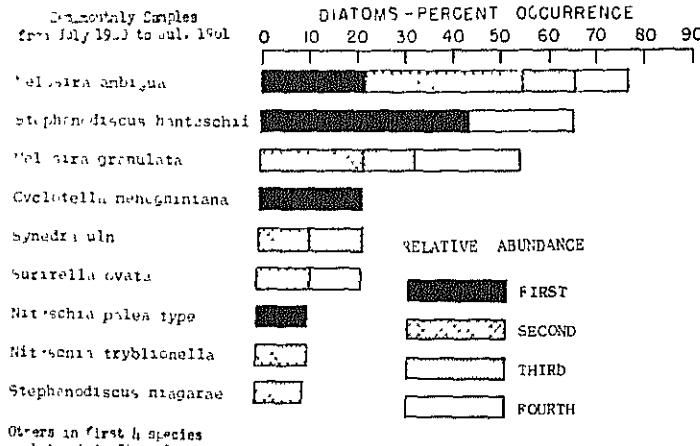
GENERA OF ALGAE

Percent frequency of counts
150 per ml. or more
From March 1960 to May 1961

Algae	Percent Frequency
Green algae	
<i>Scenedesmus</i>	9
Green flagellates	
<i>Phacus</i>	4
<i>Trachelomonas</i>	9
Other pigmented flagellates	
<i>Chromulina</i>	0
Diatoms	
Centric	
<i>Cyclotella</i>	28
<i>Melosira</i>	42
<i>Stephanodiscus</i>	28
Pennate	
<i>Asterionella</i>	14
<i>Navicula</i>	4
<i>Nitzschia</i>	4
<i>Synedra</i>	9



ARKANSAS RIVER
PENDLETON FERRY, ARKANSAS



DIATOMS - SPECIES DIVERSITY

■ FIRST 4 MOST ABUNDANT
□ ALL OTHER SPECIES
□ NO ANALYSIS MADE

ZOOPLANKTON

Samples analyzed 13
July 1960 to July 1961

Samples with Animals	Average count per liter per sample
----------------------	------------------------------------

Rotifers.	6	11.9
Keratella	2	0
Polyarthra	4	0.5
Brachionus	2	10.9
Synchaeta	0	0
Other genera	2	0.5

Crustaceans.

nauplii	1	0
copepods	2	0.5
cladocerans	1	0

Nematodes

Other invertebrate metazoans	5	0
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MOST ABUNDANT
GENERA OF ALGAE

Percent frequency of counts
150 per ml or more
From May 1959 to May 1961

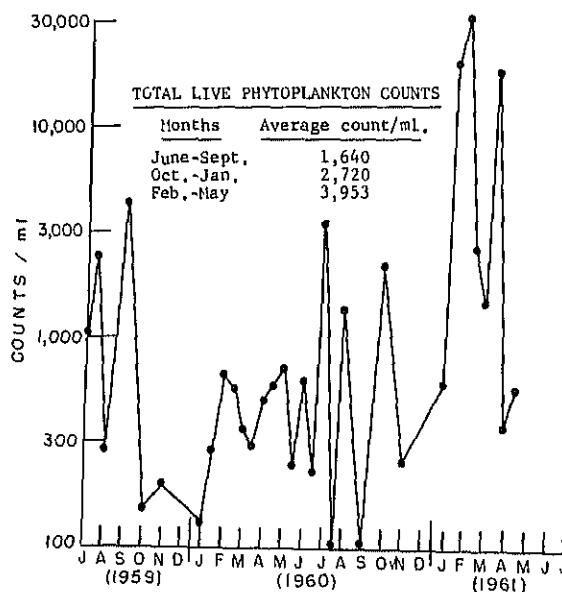
Blue-green algae
Anacystis 3

Green algae
Oocystis 3
Scenedesmus 3
Seleniastrum 3
Stichococcus 3

Green flagellates
Chlamydomonas 16
Buglena 3
Trachelomonas 11

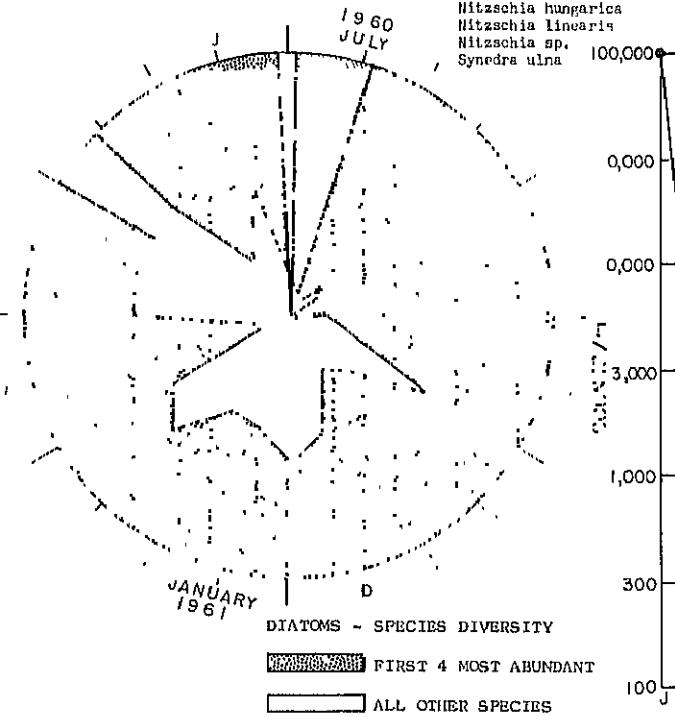
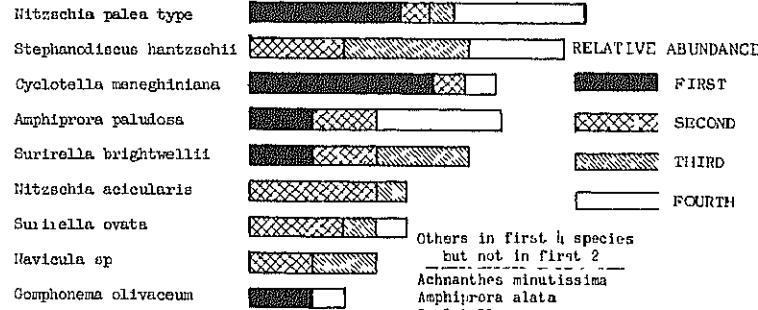
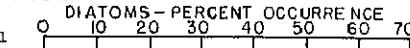
Diatoms
Centric
Cyclotella 32
Melosira 16
Stephanodiscus 24

Pennate
Amphiprora 3
Asperionella 3
Navicula 5
Nitzschia 11
Synedra 24



ARKANSAS RIVER
PONCA CITY, OKLAHOMA

Semimonthly Samples
from July 1960 to July 1961



ZOOPLANKTON

Samples analyzed 22
July 1960 to July 1961

	Samples with Animals	Average count per liter per sample
Rotifers:	7	39.0
Keratella	4	0.6
Polyarthra	1	0.3
Brachionus	5	36.0
Synchaeta	2	0
Other genera	2	1.4

MOST ABUNDANT GENERA OF ALGAE

Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

Blue-green algae	
Agmenellum	3
Anacyclis	5
Apahanizonemon	3
Gomphorphaeia	5
Oscillatoria	3
Phormidium	3

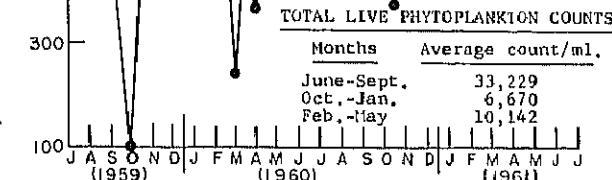
Green algae	
Actinostromum	16
Amidistodesmus	11
Chlorella-type	3
Dictyochophaeium	3
Golenkinia	1
Lagerholmia	3
Micractinium	3
Oocystis	3
Peltiastrium	5
Scenedesmus	24

Green flagellates	
Chlamydomonas	49
Puglina	5
Trachelomonas	5

Other pigmented flagellates	
Gymnodinium	3
Peridinium	3

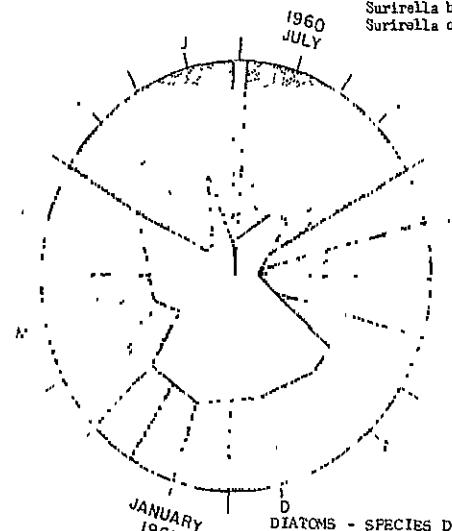
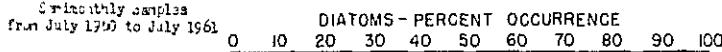
Diatoms	
Centric	
Coccinodiscus	3
Cyclotella	73
Velosia	22
Stephanodiscus	39

Pennate	
Amphiprora	19
Gomphonema	8
Meridion	3
Ophora	3
Navicula	54
Nitzschia	54
Surirella	32
Synedra	26



ARKANSAS RIVER
COOLIDGE, KANSAS

50000 samples
from July 1959 to July 1961



DIATOMS - SPECIES DIVERSITY

FIRST 4 MOST ABUNDANT
 ALL OTHER SPECIES
 NO ANALYSIS MADE

ZOOPLANKTON

Samples analyzed 20
July 1960 to July 1961

Samples with Animals	Average count per liter per sample
Rotifers	4,5
Keratella	0
Polyarthra	0
Brachionus	1
Synchaeta	0
Other genera	4,0
Crustaceans.	
nauplii	0,5
copepods	0
cladocerans	0
Nematodes	2
Other invertebrate metazoans	0

MOST ABUNDANT
GENERA OF ALGAE

Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

Blue-green algae	
<i>Agmenellum</i>	3
<i>Aphanizomenon</i>	3

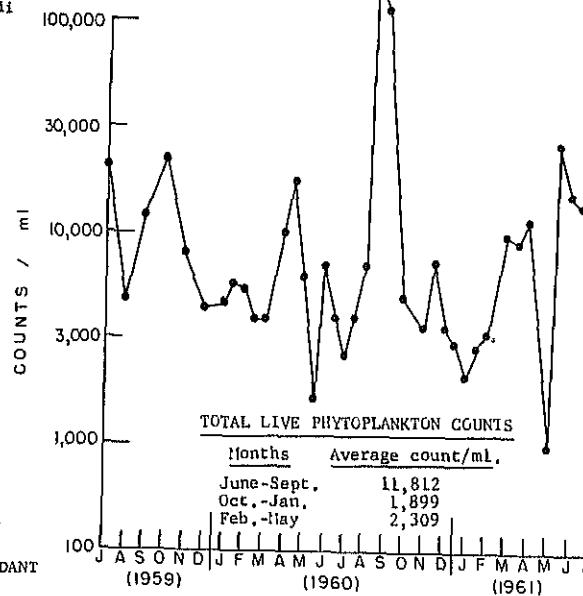
Green algae	
<i>Scenedesmus</i>	6

Green flagellates	
<i>Chlamydomonas</i>	3

Other pigmented flagellates	
<i>Peridinium</i>	3

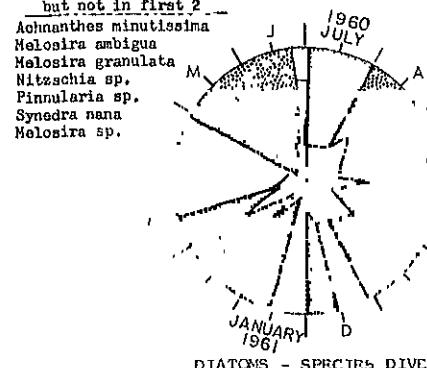
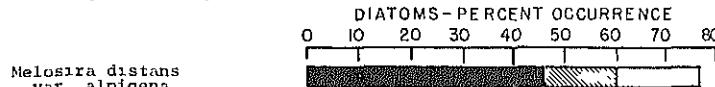
Diatoms	
Centric	
<i>Cyclotella</i>	18
<i>Melosira</i>	3

Pennate	
<i>Achnanthes</i>	3
<i>Amphiprora</i>	38
<i>Amphora</i>	9
<i>Caloneis</i>	3
<i>Cocconeis</i>	3
<i>Gomphonema</i>	9
<i>Gyrosigma</i>	3
<i>Navicula</i>	82
<i>Nitzschia</i>	62
<i>Pleurosigma</i>	6
<i>Stauroeis</i>	3
<i>Surirella</i>	32
<i>Synedra</i>	41



CHATTahoochee RIVER
COLUMBUS, GEORGIA

Semimonthly Samples
from July 1960 to July 1961



FIRST 4 MOST ABUNDANT
ALL OTHER SPECIES
NO ANALYSIS MADE

ZOOPLANKTON

Samples analyzed 21
July 1960 to July 1961

	Samples with Animals	Average count per liter per sample
Rotifers.	16	125.2
Keratella	15	25.6
Polyarthra	13	37.9
Brachionus	2	0.1
Synchaeta	4	2.2
Other genera	12	59.4
Crustaceans.		
nauplii	6	3.2
copepods	6	1.9
cladocerans	8	5.6
Nematodes		2.0
Other invertebrate metazoans	0	

MOST ABUNDANT
GENERA OF ALGAE

Percent frequency of counts
150 per ml. or more
From October 1959 to May 1961

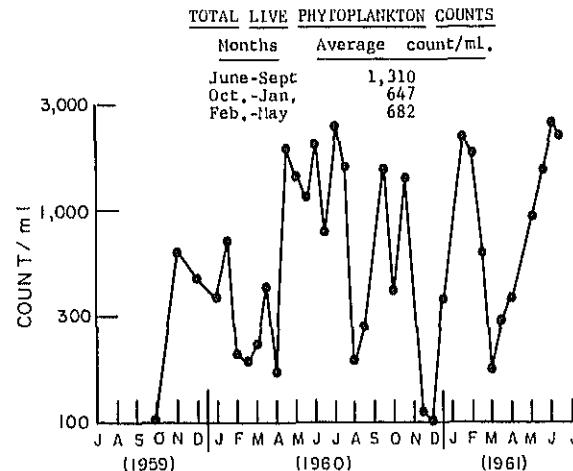
Blue-green algae	
<i>Anacystis</i>	3
<i>Raphidiopsis</i>	3
Green algae	
<i>Scenedesmus</i>	9
Green flagellates	
<i>Chlamydomonas</i>	9
<i>Trachelomonas</i>	0
Other pigmented flagellates	
<i>Chromulina</i>	18
<i>Peridinium</i>	3

Diatoms

Centric	
<i>Cyclotella</i>	15
<i>Melosira</i>	15
<i>Stephanodiscus</i>	15

Pennate

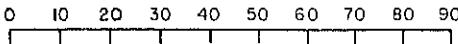
<i>Asterionella</i>	3
<i>Fragilaria</i>	3
<i>Nitzschia</i>	6
<i>Synedra</i>	9



CHATTahoochee RIVER
ATLANTA, GEORGIA

Semimonthly Samples
from July 1960 to July 1961

DIATOMS - PERCENT OCCURRENCE



Melosira distans
var. *alpigena*

Cyclotella stelligera

Achnanthes minutissima

Synedra ulna

Synedra vaucheriae

Melosira varians

Navicula sp.

Navicula mutica

Surirella angustata

Others in first 4 species
but not in first 2

Ceratoneis arcus

Cocconeis placentula

Cyclotella striata

Cymbella bentricosa

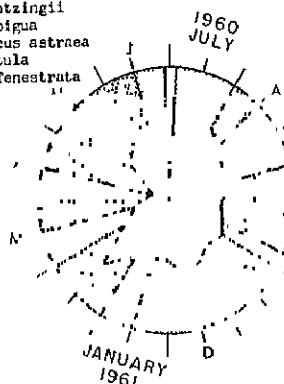
Gyrosigma kutzinigii

Melosira ambigua

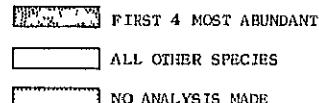
Stephanodiscus astraea

var. *minutula*

Tabellaria fenestrata



DIATOMS - SPECIES DIVERSITY



ZOOPLANKTON

Samples analyzed 22
July 1960 to July 1961

Samples with Animals	Average count per liter per sample
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Rotifers:	13	3.4
Keratella	8	1.1
Polyarthra	5	1.0
Brachionus	1	0
Synchaeta	2	0.1
Other genera	11	1.2

Crustaceans		
nauplii	3	0.3
copepods	0	0
cladocoeans	3	0.3

Nematodes	0
Other invertebrate metazoans	0

MOST ABUNDANT
GENERA G F ALGAE

Percent frequency of counts
150 per ml. or more
From June 1960 to June 1961

Green flagellates
Phacotus 4

Other pigmented flagellates
Chromulina 9

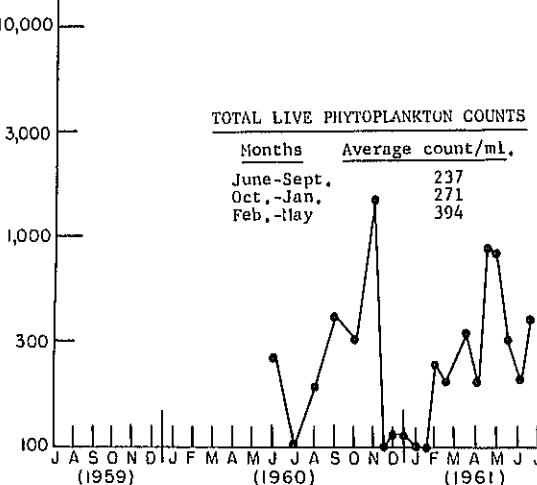
Diatoms
Centric 18
Cyclotella 13
Melosira 4

Pennate
Asterionella 13

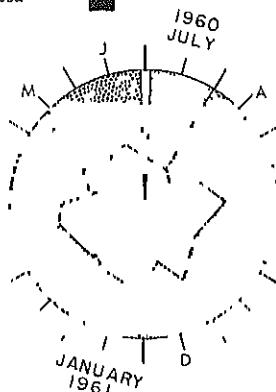
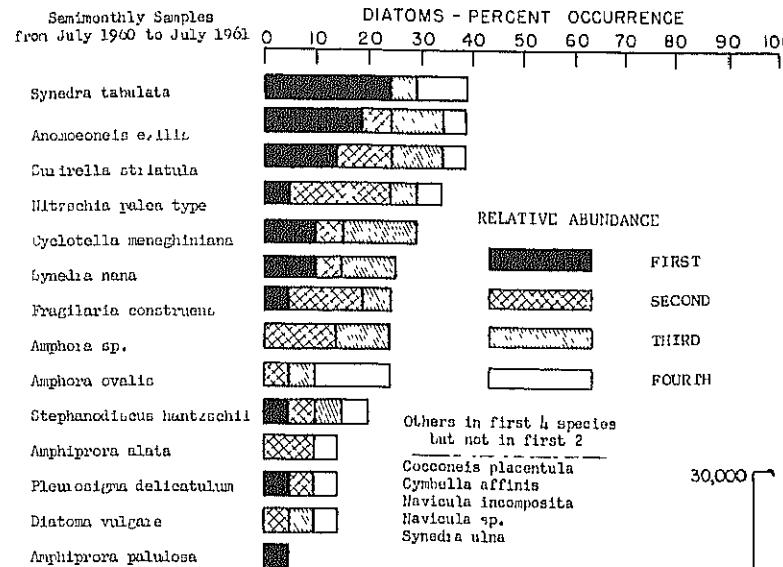
TOTAL LIVE PHYTOPLANKTON COUNTS

Months	Average count/ml.
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June-Sept.	237
Oct.-Jan.	271
Feb.-May	394



COLORADO RIVER
YUMA, ARIZONA



DIA TONS - SPECIES DIVERSITY

FIRST 4 MOST ABUNDANT
 ALL OTHER SPECIES
 NO ANALYSIS MADE

ZOOPLANKTON

Samples analyzed 23
July 1960 to July 1961

	Samples with Animals	Average count per liter per sample
Rotifers:	9	2.0
Keratella	5	0
Polyarthra	3	0
Brachionus	5	0.5
Synchaeta	5	0
Other genera	7	1.5
Crustaceans.		
nauplii	7	1
copepods	5	0
cladocerans	2	0
Nematodes		2
Other invertebrate metazoans		0

MOST ABUNDANT
GENERA OF ALGAE

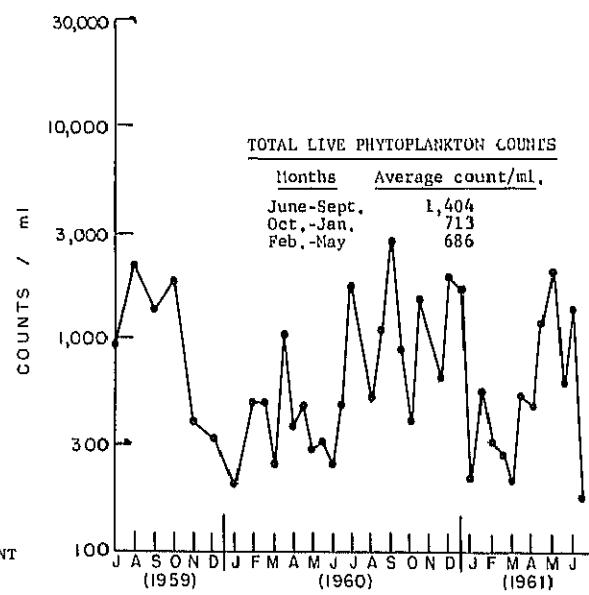
Percent frequency of counts
150 per ml. or more
from May 1959 to May 1961

Blue-green algae
Anacystis 5
Cylindrospermum 3

Green algae

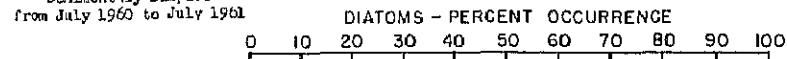
Diatoms
Centric
Cyclotella 10
Stephanodiscus 11

Pennate	
<i>Amphora</i>	8
<i>Anomoeoneis</i>	11
<i>Fragilaria</i>	8
<i>Navicula</i>	11
<i>Kitchochia</i>	11
<i>Jugaria</i>	28



COLORADO RIVER
PAGE, ARIZONA

Semimonthly Samples
from July 1960 to July 1961



RELATIVE ABUNDANCE

FIRST

SECOND

THIRD

FOURTH

Others in First 4 species
but not in first 2

Caloneis amphibiaena

Gymnella affinis

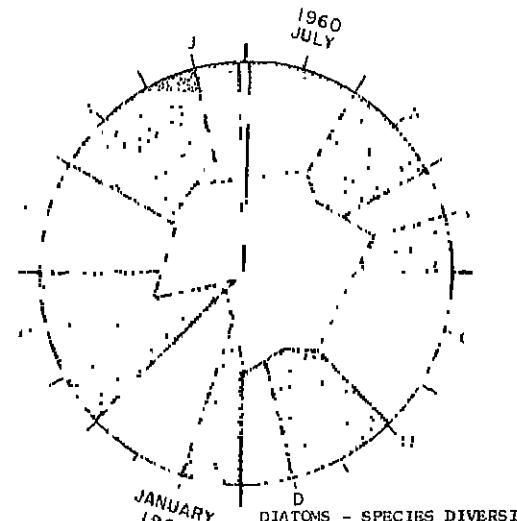
Distoma elongatum

Epithemia soror

Nitzschia palea type

Rhopalodia gibba

Synedra vaucheriae



FIRST 4 MOST ABUNDANT

ALL OTHER SPECIES

NO ANALYSIS MADE

ZOOPLANKTON

Samples analyzed 18
July 1960 to July 1961

Samples with Animals	Average count per liter	per sample
----------------------	-------------------------	------------

Rotifers:	9	2.0
Keratella	5	0
Polyarthra	3	0
Brachionus	5	0.5
Synchaeta	5	2.0
Other genera	4	1.5

Crustaceans.		
nauplii	7	1.0
copepods	5	0
cladocerans	2	0
Nematodes		0
Other invertebrate metazoans		0

MOST ABUNDANT
GENERA OF ALGAE

Percent frequency of counts
150 per ml. or more
From Dec. 1959 to May 1961

Green Algae	
Ankistrodesmus	3
Scenedesmus	9

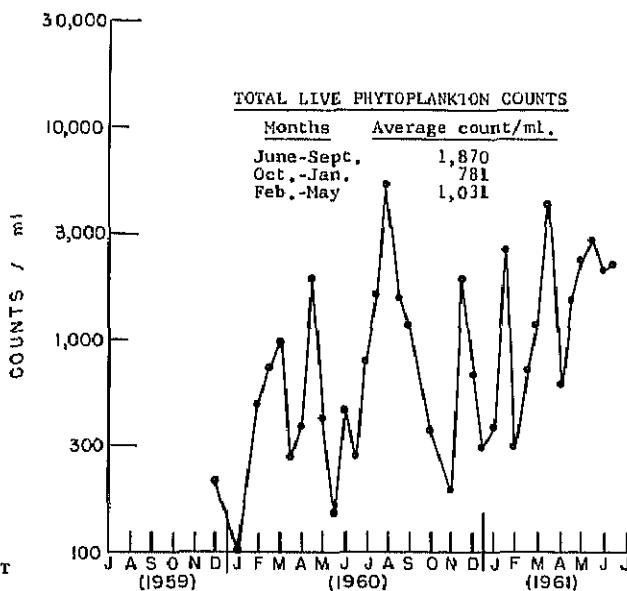
Green flagellates	
Chlamydomonas	6

Diatoms	
Centro	
Cyclotella	
Stephanodiscus	19
Centro	22

Pennate	
Cymbella	6
Diatoma	6
Epithemia	3
Fragilaria	6
Gomphonema	3
Navicula	9
Nitzschia	12
Surirella	9
Synedra	38

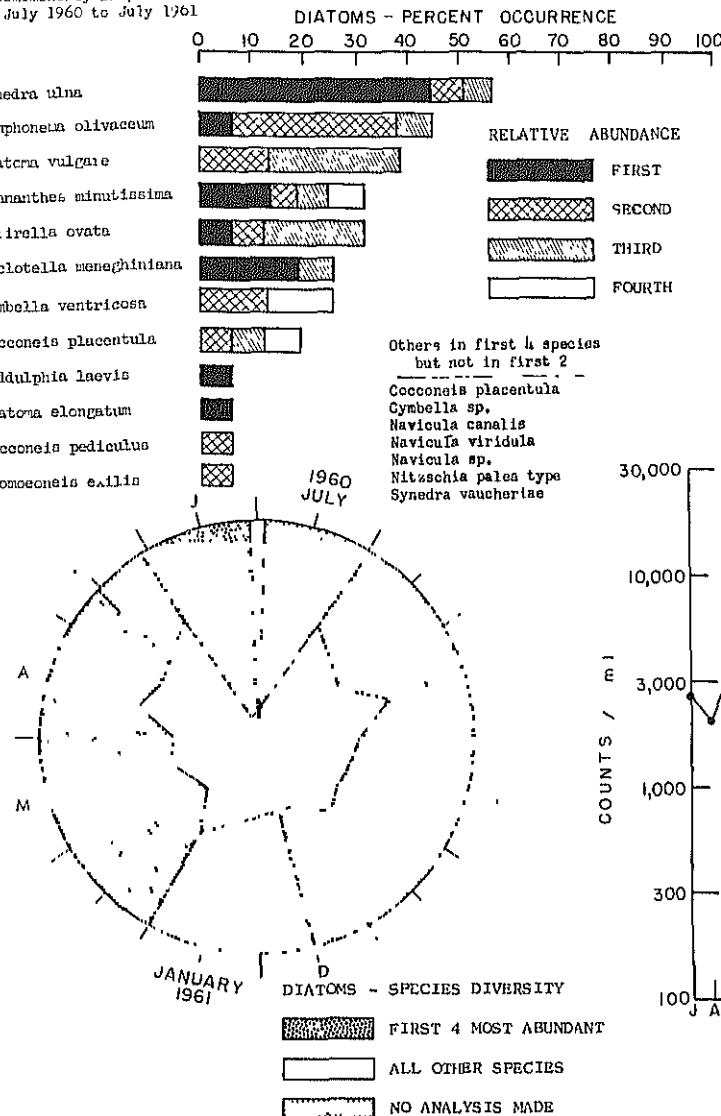
TOTAL LIVE PHYTOPLANKTON COUNTS

Months	Average count/ml.
June-Sept.	1,870
Oct.-Jan.	781
Feb.-May	1,031



COLORADO RIVER LOMA, COLORADO

Semimonthly Samples
from July 1960 to July 1961



ZOOPLANKTON

Samples analyzed 19
July 1960 to July 1961

Samples with Animals	Average count per liter per sample
Rotifers:	0.6
Keratella	0
Polyarthra	0
Brachionus	0
Synchaeta	0.6
Other genera	0.6
Crustaceans:	
nauplii	0
copepods	0
cladocerans	0
Nematodes	1
Other invertebrate metazoa	0

MOST ABUNDANT GENERA OF ALGAE

Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

Blue-green algae	
Anacystis	2
Green algae	
Tetradesmus	2

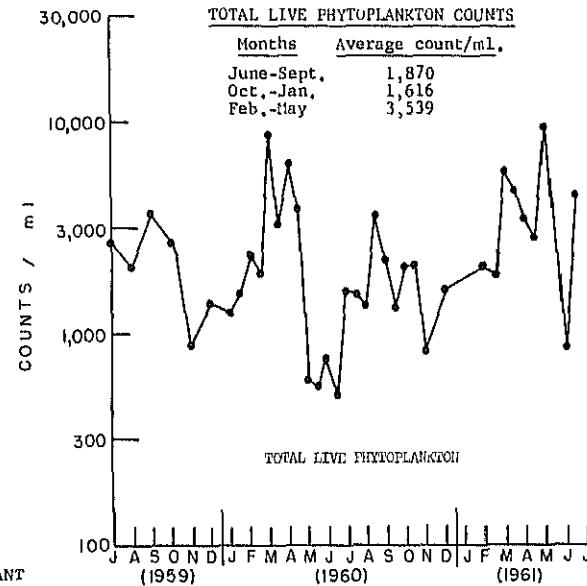
Diatoms	
Centric	50
Cyclotella	5
Stephanodiscus	5

Pennate	
Achnanthes	22
Cocconeis	15
Cymbella	52
Diatoma	26
Fragilaria	2
Gomphonema	52
Navicula	69
Nitzschia	16
Surirella	19
Synedra	75
Stauroeis	2
Opephora	2

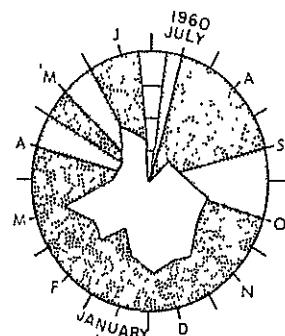
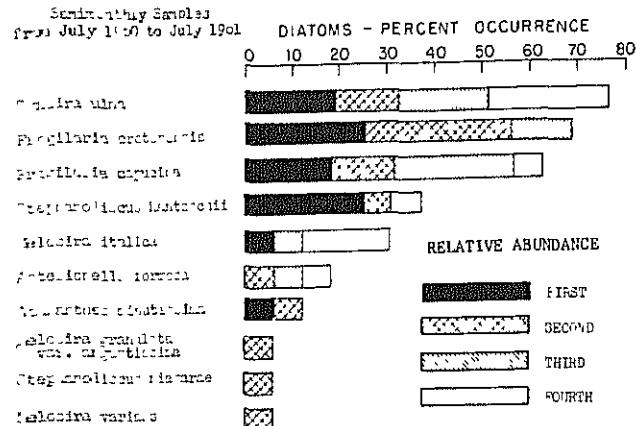
TOTAL LIVE PHYTOPLANKTON COUNTS

Months Average count/ml.

June-Sept.	1,870
Oct.-Jan.	1,616
Feb.-May	3,539



COLUMBIA RIVER
CLATSASKIE, OREGON



DIATOMS - SPECIES DIVERSITY

■ FIRST 4 MOST ABUNDANT

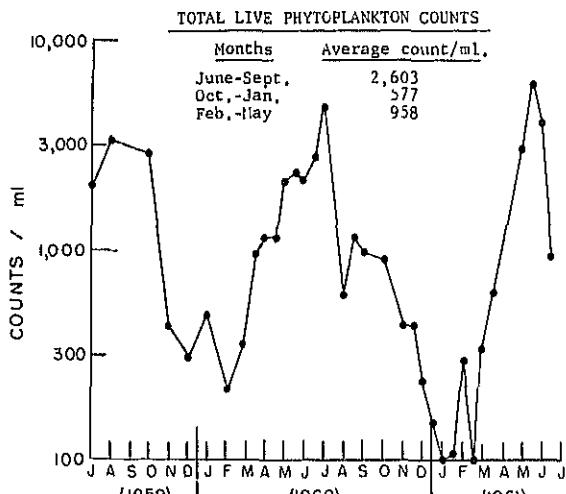
■ ALL OTHER SPECIES

■ NO ANALYSIS MADE

ZOOPLANKTON

Samples analyzed 22
July 1960 to July 1961

Samples with Animals	Average count per liter per sample
Rotifers	46.8
Keratella	23.0
Polyarthra	12.0
Brachionus	2.7
Synchaeta	0.6
Other genera	8.5
Crustaceans	
nauplii	1.0
copepods	0.6
cladocerans	1.0
Nematodes	0
Other invertebrate metazoans	0



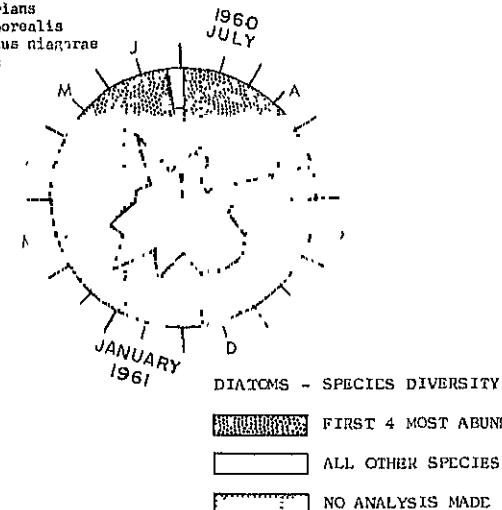
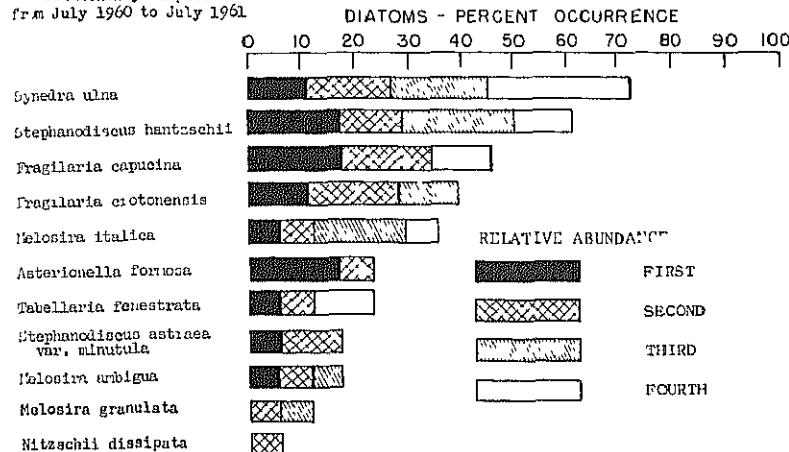
MOST ABUNDANT
GENERA G F ALGAE

Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

Blue-green algae	
Anacystis	3
Phormidium	3
Green algae	
chlorella-type	3
Stichococcus	6
Diatoms	
Centric	
Cyclotella	19
Melosira	32
Stephanodiscus	31
Pennate	
Achnanthes	6
Asterionella	19
Fragilaria	25
Navicula	9
Synedra	19
Tabellaria	6

COLUMBIA RIVER
BONNEVILLE, OREGON

Semi-monthly Samples
from July 1960 to July 1961



ZOOPLANKTON

Samples analyzed 21
July 1960 to July 1961

Samples with Animals Average count per liter/sample

Rotifers	10	18.9
Keratella	10	12.0
Polyarthra	6	3.0
Brachionus	4	0.8
Synchaeta	2	0.6
Other genera	8	3.3
Crustaceans:		
nauplii	3	0
copepods	2	0
cladocerans	2	0
Other invertebrate metazoans	0	0

MOST ABUNDANT GENERA OF ALGAE

Incident frequency of counts
100 per ml. or more
July 1959 to May 1961

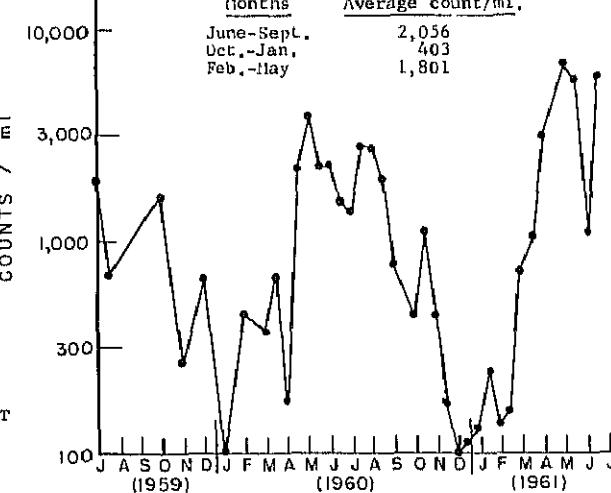
Blue-green algae
Anabaena 3
Phormidium 6

Diatoms
Centric
Cyclotella 23
Melosira 26
Stephanodiscus 29

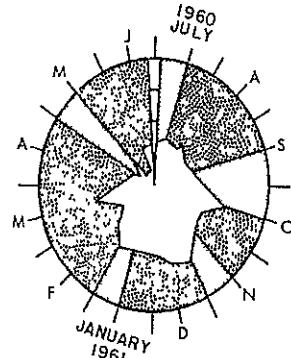
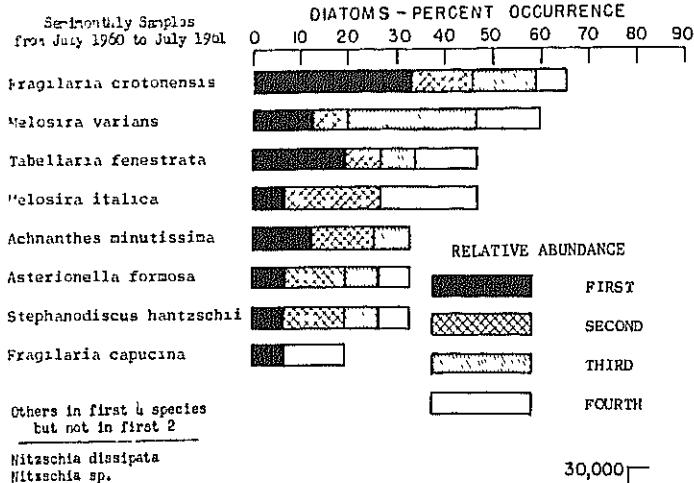
Pennate
Achnanthes 3
Asterionella 31
Diatom 3
Fragilaria 29
Navicula 11
Nitzschia 6
Synedra 29
Tabellaria 11

TOTAL LIVE PHYTOPLANKTON COUNTS

Months	Average count/ml.
June-Sept.	2,056
Oct.-Jan.	403
Feb.-May	1,801



COLUMBIA RIVER
PASCO, WASHINGTON



DIATOMS - SPECIES DIVERSITY

■■■■	FIRST 4 MOST ABUNDANT
□□□□	ALL OTHER SPECIES
▨▨▨▨	NO ANALYSIS MADE

ZOOPLANKTON

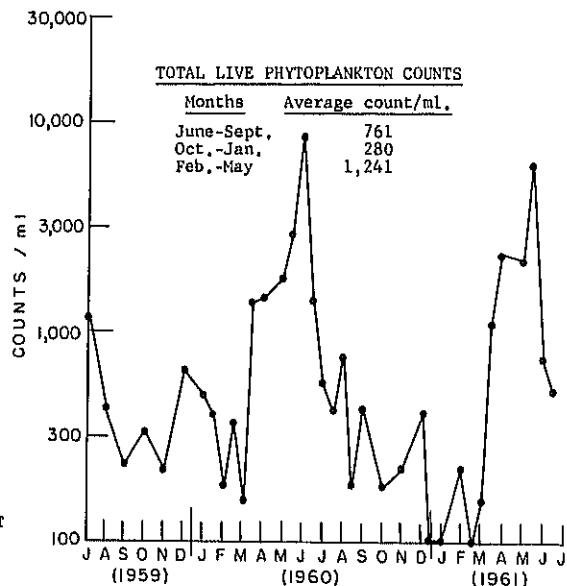
Samples analyzed 19
July 1960 to July 1961

Samples with Animals	Average count per liter per sample
Rotifers.	14
Keratella	6
Polyarthra	7
Brachionus	2
Synchaeta	3
Other genera	8
Crustaceans.	
nauplii	2
copepods	2
cladocerans	1
Nematodes	0
Other invertebrate metazoans	0

MOST ABUNDANT GENERA OF ALGAE

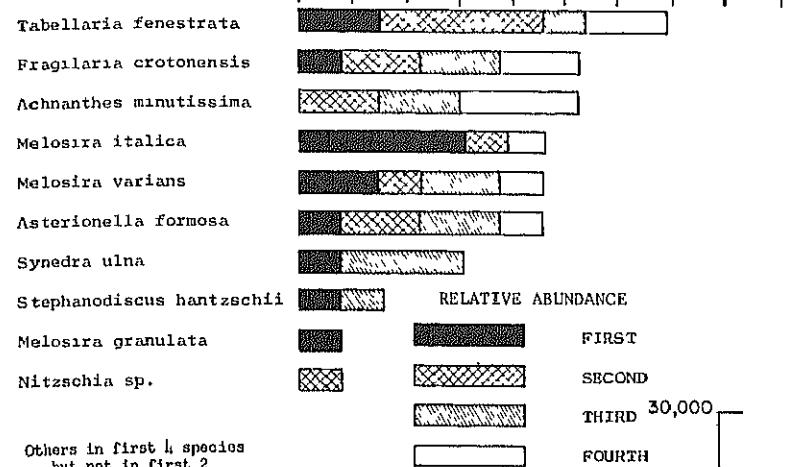
Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

Blue-green algae	Phormidium	3
Diatoms		
Centric		
Cyclotella	6	
Melosira	31	
Stephanodiscus	11	
Pennate		
Achnanthes	9	
Asterionella	31	
Fragilaria	14	
Nitzschia	9	
Synedra	23	
Tabellaria	34	



COLUMBIA RIVER
WENATCHEE, WASHINGTON

Semimonthly Samples
from July 1960 to July 1961



DIATOMS - SPECIES DIVERSITY

■ FIRST 4 MOST ABUNDANT
■ ALL OTHER SPECIES
■ NO ANALYSIS MADE

ZOOPLANKTON

Samples analyzed 17
July 1960 to July 1961

Samples Average count
with per liter
Animals per sample

Rotifers:	8	3.7
Keratella	6	1.7
Polyarthra	1	0
Brachionus	0	0
Synchaeta	1	0
Other genera	8	2.7

Crustaceans:		
nauplii	1	0
copepods	0	0
cladocerans	2	0

Nematodes	0	
Other invertebrate metazoans	0	

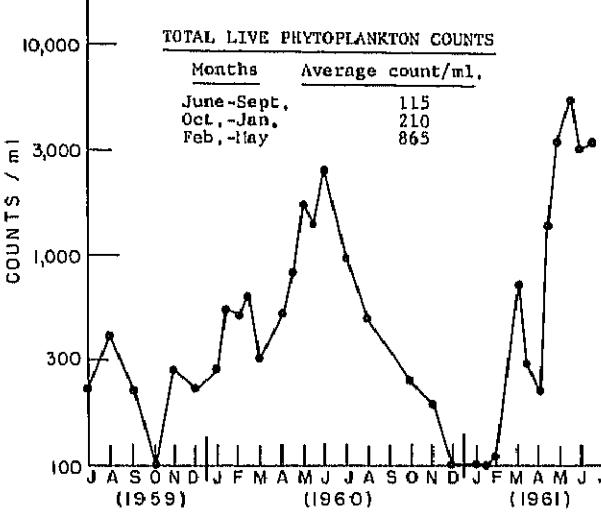
MOST ABUNDANT
GENERA OF ALGAE

Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

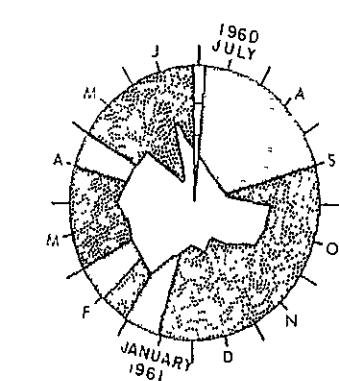
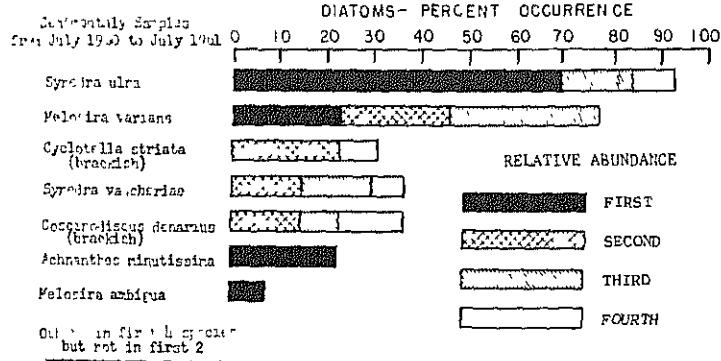
Diatoms		
Centric		
Cyclotella	7	
Melosira	10	
Pennate		
Achnanthes	10	
Asterionella	31	
Fragilaria	7	
Nitzschia	3	
Synedra	14	
Tabellaria	45	

TOTAL LIVE PHYTOPLANKTON COUNTS

Months	Average count/ml.
June-Sept.	115
Oct.-Jan.	210
Feb.-May	865



DEL AWARE RIVER
PHILADELPHIA, PA

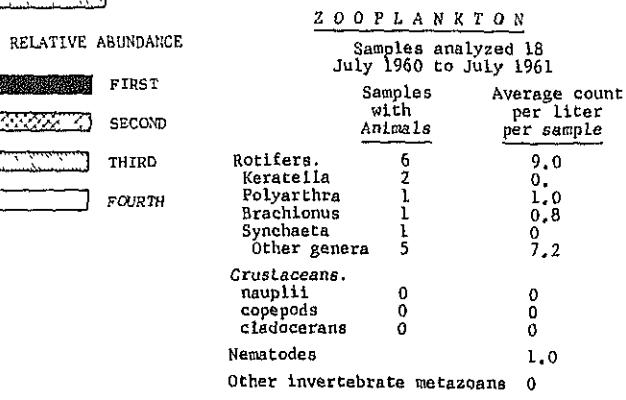


DIATOMS - SPECIES DIVERSITY

■ FIRST 4 MOST ABUNDANT

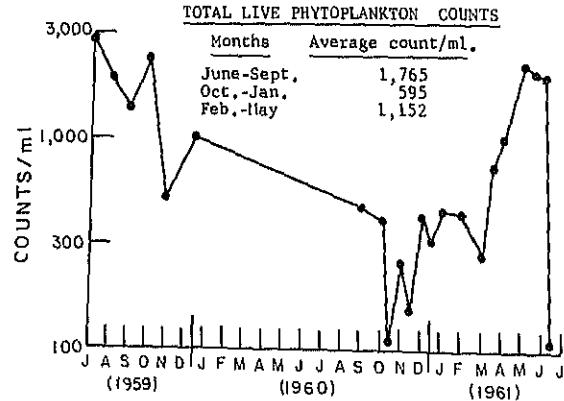
■ ALL OTHER SPECIES

■ NO ANALYSIS MADE



MOST ABUNDANT
GENERA OF ALGAE

Percent frequency of counts 150 per ml. or more From May 1959 to May 1961	
Blue-green algae	
Anacystis	14
Green algae	
Actinostrium	5
Andiotaedonius	5
Chlorella-type	5
Oocystis	5
Scenedesmus	14
Green flagellates	
Chlamydomonas	5
Other pigmented flagellates	
Garamonas	5
Diatoms	
Centric	
Cyclotella	
Melosira	10
Pennate	
Astrocionella	5
Fragilaria	5
Gomphonema	5
Navicula	5
Syndra	52



DELAWARE RIVER

MARTINS CREEK, PENNSYLVANIA

Semimonthly Samples
from July 1960 to July 1961

DIATOMS - PERCENT OCCURRENCE
0 10 20 30 40 50 60 70

Achnanthes minutissima

Melosira varians

Synedra vaucheriae

Diatoma vulgare

Cymbella ventricosa

Synedra ulna

Asterionella formosa

Ceratoneis arcus

Nitzschia palea type

Cocconeis placentula

Achnanthes sp.

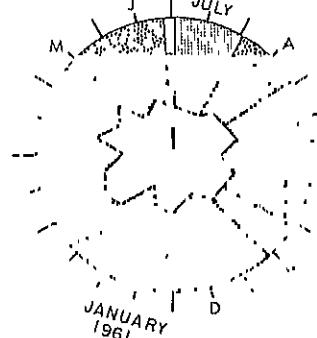
Others in first 4 species
but not in first 2

Navicula cryptocephala

Navicula tripunctata

Nitzschia lanceolata group

Synedra pulchella



DIATOMS - SPECIES DIVERSITY

FIRST 4 MOST ABUNDANT

ALL OTHER SPECIES

NO ANALYSIS MADE

ZOOPLANKTON

Samples analyzed 23
July 1960 to July 1961

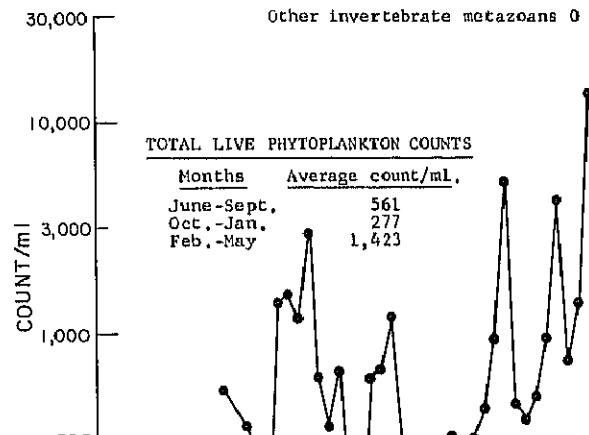
Samples with Animals	Average count per liter per sample
----------------------	------------------------------------

Rotifers:	16	6.3
Keratella	10	1.6
Polyarthra	5	0.4
Brachionus	1	0
Synchaeta	5	0.4
Other genera	12	3.9

Crustaceans:		
nauplii	2	0.1
copepods	3	0.1
cladocerans	1	0.1

Nematodes	2	
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Other invertebrate metazoans	0	
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MOST ABUNDANT GENERAL OF ALGAE

Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

Green algae
Scenedesmus 6

Green flagellates
Chlamydomonas 3
Chlorobranchis 3

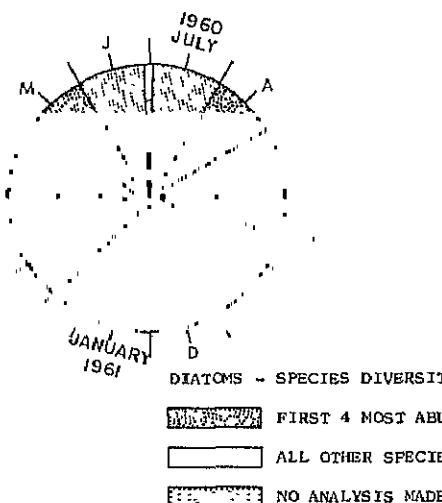
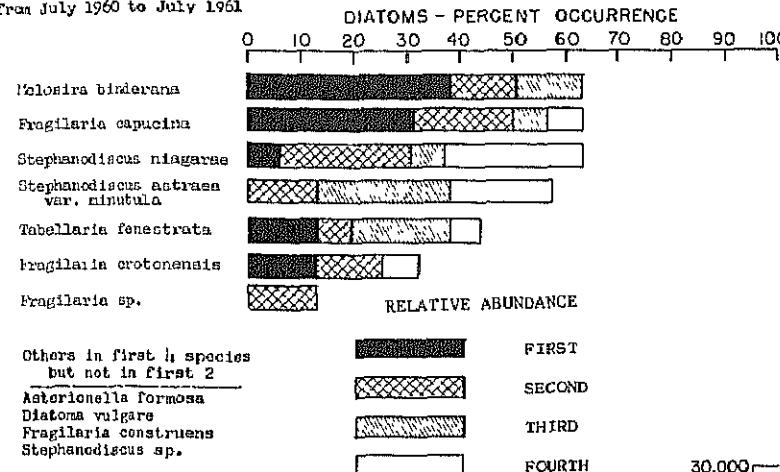
Other pigmented flagellates
Chromulina 3

Diatoms
Centric
Cyclotella 6
Melosira 9
Stephanodiscus 3

Pennate
Achnanthes 6
Asterionella 16
Ceratoneis 6
Cocconeis 3
Cymbella 13
Diatoma 16
Fragilaria 6
Navicula 6
Nitzschia 3
Synedra 25

GREAT LAKES, LAKE ERIE, NIAGARA RIVER
BUFFALO, NEW YORK

Semimonthly Samples
from July 1960 to July 1961



ZOOPLANKTON

Samples analyzed 23
July 1960 to July 1961

Animals	Samples	Average count per liter per sample
Rotifers	23	66.1
Keratella	23	27.5
Polyarthra	20	30.0
Brachionus	4	0.6
Synchaeta	5	1.0
Other genera	18	6.9

MOST ABUNDANT GENERA OF ALGAE

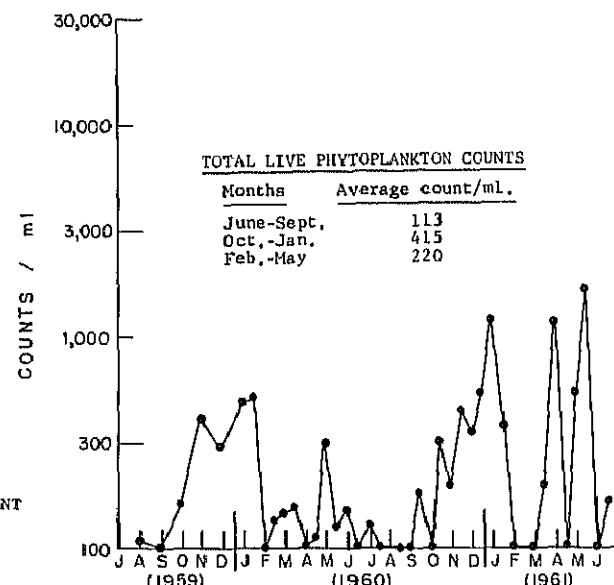
Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

Diatoms	
Centric	
Cyclotella	5
<i>Melosira</i>	7
<i>Stephanodiscus</i>	17

Pennate	
<i>Asterionella</i>	2
<i>Diatoma</i>	2

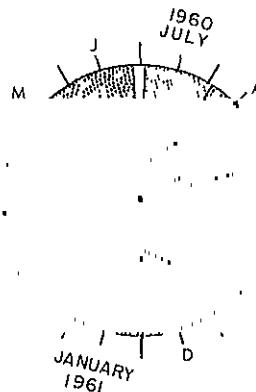
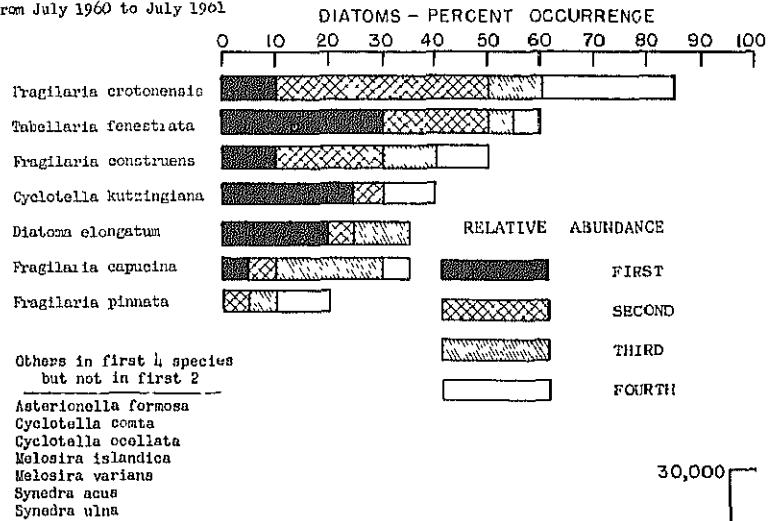
TOTAL LIVE PHYTOPLANKTON COUNTS

Months	Average count/ml.
June-Sept.	113
Oct.-Jan.	415
Feb.-May	220



GREAT LAKES, LAKE HURON, DETROIT RIVER
DETROIT, MICHIGAN

Semimonthly Samples
from July 1960 to July 1961



DIATOMS - SPECIES DIVERSITY

Legend: Hatched bar = FIRST 4 MOST ABUNDANT, White bar = ALL OTHER SPECIES, Dotted bar = NO ANALYSIS MADE.

ZOOPLANKTON

Samples analyzed 23
July 1960 to July 1961

Samples with Animals	Average count per liter per sample
Rotifers:	6.3
Keratella	3.4
Polyarthra	0.9
Brachionus	0.8
Synchaeta	0.4
Other genera	0.8
Crustaceans:	
nauplii	0.6
copepods	0.9
cladocerans	1.9
Nematodes	1.
Other invertebrate metazoans	0

MOST ABUNDANT GENERA OF ALGAE

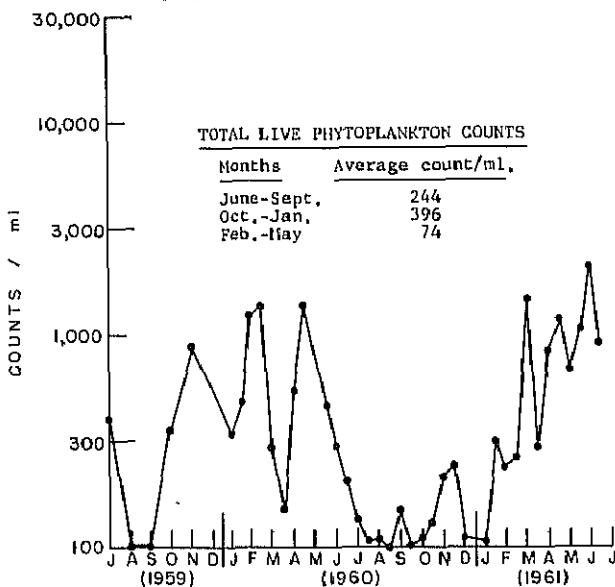
Percent frequency of counts
150 per ml. or more
from May 1959 to May 1961

Diatoms
Centric
Cyclotella 5
Stephanodiscus 5

Pennate
Asterionella 17
Diatoms 17
Fragilaria 12
Synedra 12
Tabellaria 10

TOTAL LIVE PHYTOPLANKTON COUNTS

Months	Average count/ml.
June-Sept.	244
Oct.-Jan.	396
Feb.-May	74



GREAT LAKES, LAKE HURON, ST CLAIR RIVER
PORT HURON, MICHIGAN

Semimonthly Samples
from July 1960 to July 1961

DIATOMS - PERCENT OCCURRENCE

Fragilaria construens

Fragilaria crotonensis

Tabellaria fenestrata

Fragilaria pinnata

Cyclotella kutzningiana

Fragilaria capucina

Cyclotella sp.

Others in first 4 species
but not in first 2

Achnanthus minutissima

Amphora ovalis

Cyclotella ocellata

Diatoma elongatum

Diatoma vulgare

Fragilaria leptostauron

Synedra acus

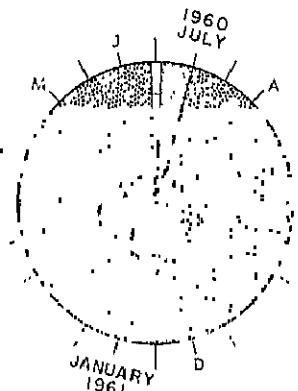
RELATIVE ABUNDANCE

FIRST

SECOND

THIRD

FOURTH



DIATOMS - SPECIES DIVERSITY

FIRST 4 MOST ABUNDANT

ALL OTHER SPECIES

NO ANALYSIS MADE

ZOOPLANKTON

Samples analyzed 24
July 1960 to July 1961

Samples with
Average count
Animals per liter
per sample

Rotifars:	20	22.2
Keratella	14	12.0
Polyarthra	9	4.5
Brachionus	5	0.5
Synchaeta	4	0.5
Others	16	4.7

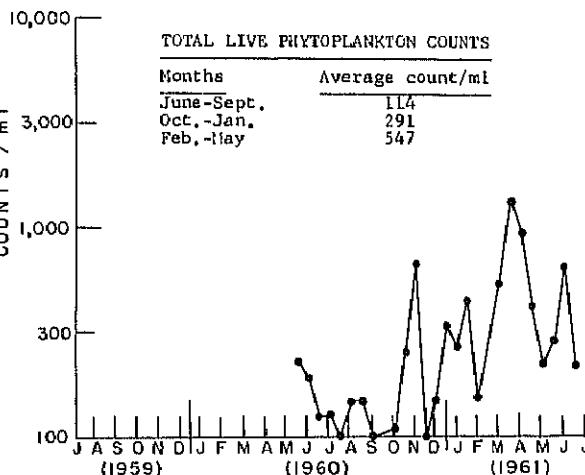
Crustacea:		
Nauplii	11	2.3
Copepods	16	6.1
Cladocera	11	2.3

Other invertebrate metazoans 0

MOST ABUNDANT
GENERA OF ALGAE

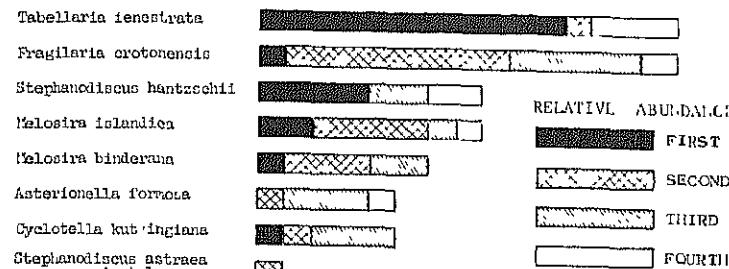
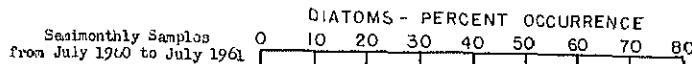
Percent frequency of counts
150 per ml. or more
From May 1960 to May 1961

Diatoms	
Centric	
<i>Cyclotella</i>	4
<i>Stephanodiscus</i>	4
Pennate	
<i>Asterionella</i>	8
<i>Diatoma</i>	4
<i>Fragilaria</i>	13



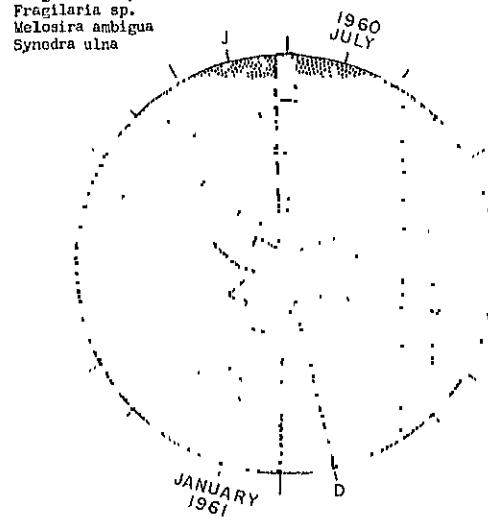
GREAT LAKES, LAKE MICHIGAN

GARY, INDIANA



Others in first 4 species but not in first 2

Cyclotella comta
Diatoma vulgare
Fragilaria capucina
Fragilaria sp.
Melosira ambigua
Synedra ulna



DIATOMS - SPECIES DIVERSITY

FIRST 4 MOST ABUNDANT

ALL OTHER SPECIES

NO ANALYSIS MADE

ZOOPLANKTON

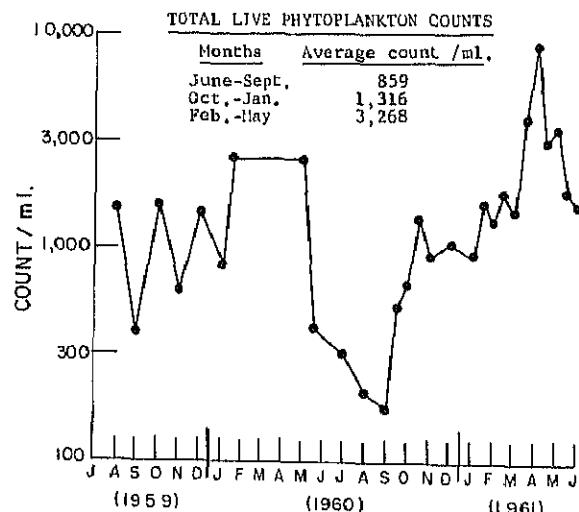
Samples analyzed 21 July 1960 to July 1961

	Samples with Animals	Average count per liter per sample
Rotifers:	17	16.2
Keratella	11	6.8
Polyarthra	5	0.7
Brachionus	5	1.6
Synchaeta	2	0
Other genera	15	7.1
Crustaceans:		
nauplii	6	0
copepods	7	0
cladocerans	6	2.7
Nematodes		0
Other invertebrate metazoans		0

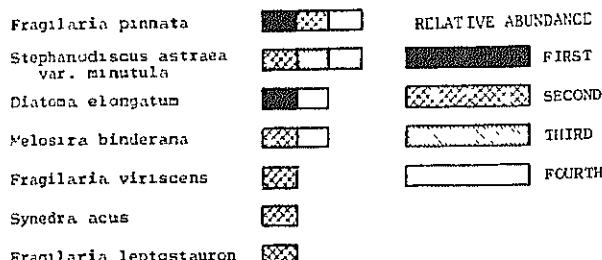
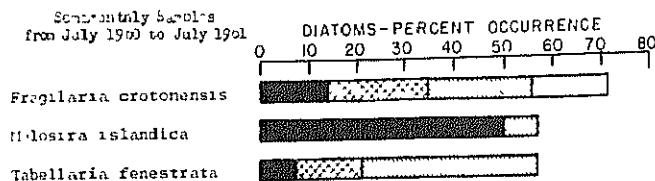
MOST ABUNDANT GENERA OF ALGAE

Percent frequency of counts 150 per ml. or more From May 1959 to May 1961

Blue-green algae	
Anacyclis	3
Green algae	
Oocystis	3
Diatoms	
Centric	
Cyclotella	25
Melosira	55
Entziosolenia	3
Stephanodiscus	21
Phaeophyceae	
Asterionella	16
Diatoma	3
Fragilaria	18
Mitschelia	3
Synedra	32
Tabellaria	54

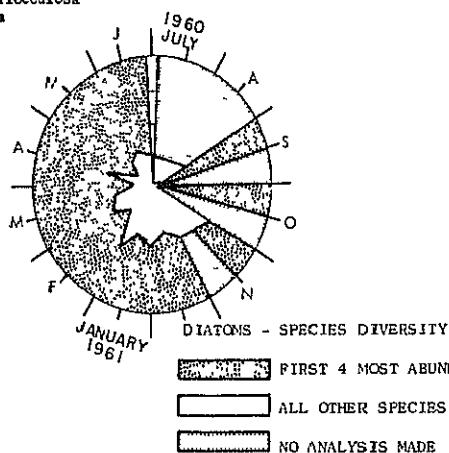


GREAT LAKES, LAKE MICHIGAN
MILWAUKEE, WISCONSIN



Others in first 4 species
but not in first 2

Asterionella formosa
Cyclotella comta
Cyclotella kutziniana
Fragilaria capucina
Stephanodiscus "michiganiana"
Tabellaria flocculosa
Synedra ulna



ZOOPLANKTON

Samples analyzed 19
July 1960 to July 1961

Samples with Animals	Average count per liter
Rotifers: 16	8.3
Keratella 11	2.2
Polyarthra 5	2.2
Brachionus 8	1.1
Synchaeta 4	0.7
Other genera 13	2.1
Crustaceans	
nauplii 9	2.1
copepods 13	2.9
cladocerans 6	0.8
Nematodes	0
Other invertebrate metazoans	0.8

MOST ABUNDANT
GENERA OF ALGAE

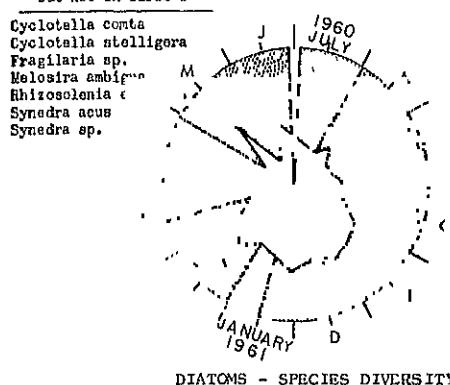
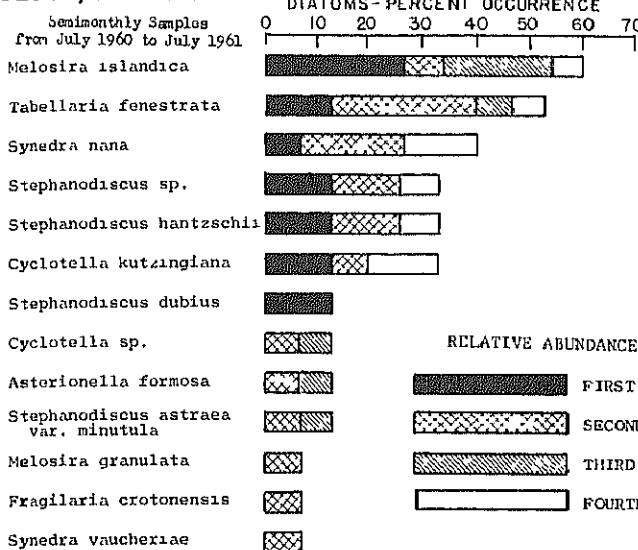
Percent frequency of counts
150 per ml. or more
From Sept. 1960 to Sept. 1961

TOTAL LIVE PHYTOPLANKTON COUNTS	
Months	Average count/ml.
June-Sept.	1,019
Oct.-Jan.	792
Feb.-May	1,113

COUNT / ml

Diatoms	
Centric	
Cyclotella	15
Melosira	15
Stephanodiscus	55
Pennate	
Fragilaria	10
Synedra	20
Tabellaria	10

GREAT LAKES, LAKE SUPERIOR
DULUTH, MINNESOTA



■ FIRST 4 MOST ABUNDANT
■ ALL OTHER SPECIES
■ NO ANALYSIS MADE

ZOOPLANKTON

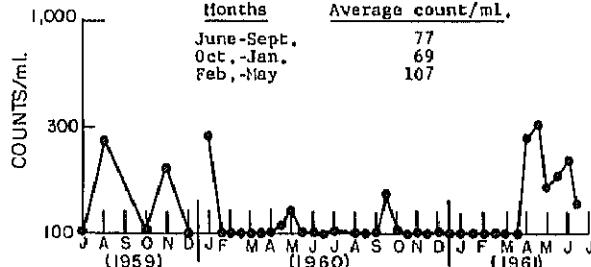
Samples analyzed 2h
July 1960 to July 1961

	Samples with Animals	Average count per liter per sample
Rotifers:	8	1.3
Keratella	8	0.3
Polyarthra	1	0
Brachionus	0	0
Synchaeta	2	0.2
Others	5	0.8
Crustaceans:		
nauplii	3	0.3
copepods	4	0.3
cladocerans	2	0.2
Other invertebrate metazoans	0	

THERE WERE NO GENERA OF ALGAE WITH COUNTS OVER 150 per ml.

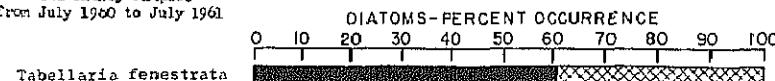
TOTAL LIVE PHYTOPLANKTON COUNTS

Months	Average count/ml.
June-Sept.	77
Oct.-Jan.	69
Feb.-May	107



GREAT LAKES, LAKE SUPERIOR, ST MARY'S RIVER
SAULT STE. MARIE, MICHIGAN

Semi-monthly Samples
from July 1960 to July 1961



RELATIVE ABUNDANCE

FIRST

SECOND

THIRD

FOURTH

THERE WERE NO GENERA OF
ALGAE WITH COUNTS OVER
150 per ml.

ZOOPLANKTON

Samples analyzed 23
July 1960 to July 1961

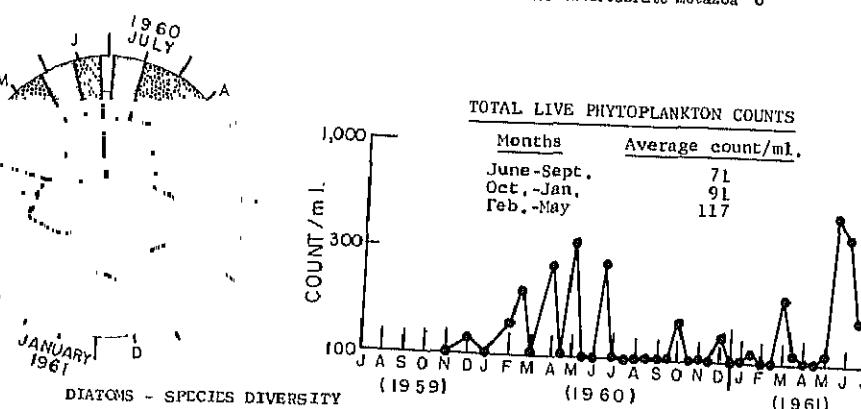
	Samples with Animals	Average count per liter per sample
Rotifers:	15	7.7
Keratella	14	2.3
Polyarthra	6	1.3
Brachionus	3	0.1
Synchaeta	4	0.8
Other genera	9	4.4

	nauplii	0.9
copepods	6	0.9
cladocerans	3	0.2

Other invertebrate metazoa 0

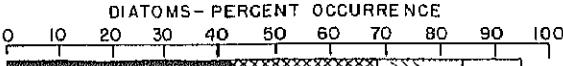
TOTAL LIVE PHYTOPLANKTON COUNTS

Months	Average count/ml.
June-Sept.	71
Oct.-Jan.	91
Feb.-May	117



HUDSON RIVER
POUGHKEEPSIE, NEW YORK

Semimonthly Samples
from July 1960 to July 1961



Melosira granulata

Melosira ambigua

Cyclotella striata
(brackish)

Coscinodiscus denarius
(brackish)

Synedra ulna

Cyclotella meneghiniana

Stephanodiscus hantzschii

Navicula peregrina
(brackish)

Diatoma vulgare

Others in first 4 species
but not in first 2

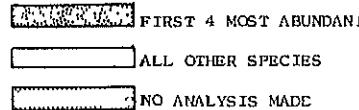
Melosira distans var. *alpigena*

Melosira varians

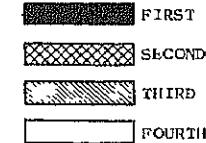


JANUARY
1961

DIATOMS - SPECIES DIVERSITY



RELATIVE ABUNDANCE



ZOOPLANKTON

Samples analyzed 22
July 1960 to July 1961

	Samples with Animals	Average count per liter per sample
Rotifers	17	8.0
Keratella	12	2.1
Polyarthra	3	0.2
Brachionus	4	0.2
Synchaeta	2	0.1
Other genera	14	5.4
Crustaceans		
nauplii	7	0.6
copepods	5	0.6
cladocerans	5	0.6
Nematodes		2
Other invertebrate metazoans	0	

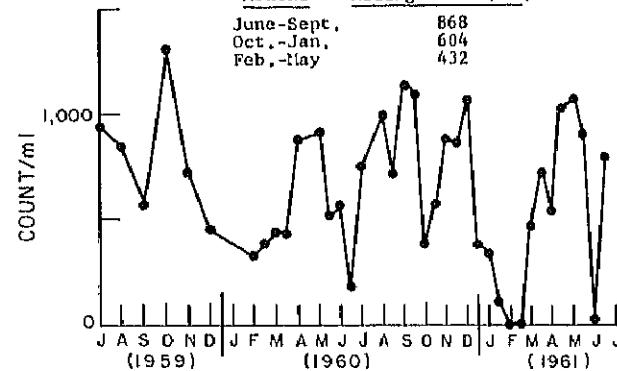
MOST ABUNDANT
GENERA OF ALGAE

Percent frequency of counts
150 per ml, or more
From May 1959 to May 1961

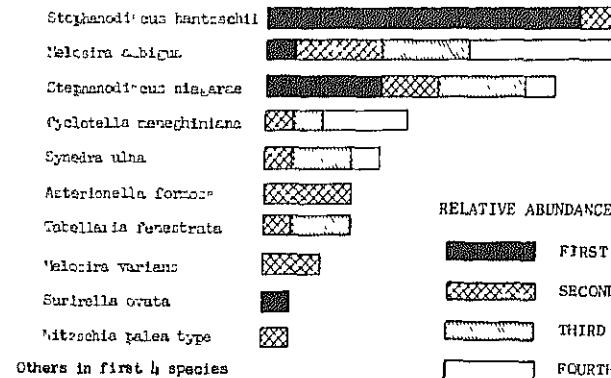
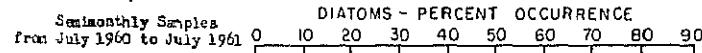
Blue-green algae	
Anacystis	3
Green algae	
Scenedesmus	6
Tetrastrum	3
Diatoms	
Centric	
Coscinodiscus	6
Cyclotella	26
Melosira	31
Stephanodiscus	3
Pennate	
Synedra	9

TOTAL LIVE PHYTOPLANKTON COUNTS

Months	Average count/ml.
June-Sept.	868
Oct.-Jan.	604
Feb.-May	432

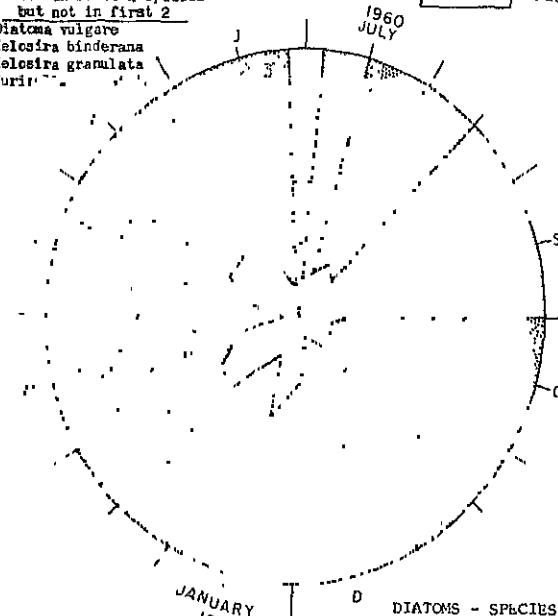


ILLINOIS RIVER
PEORIA, ILLINOIS



Others in first 4 species
but not in first 2

Diatoma vulgaris
Melosira binderiana
Melosira granulata
Surirella



FIRST 4 MOST ABUNDANT

ALL OTHER SPECIES

NO ANALYSED DATA

ZOOPLANKTON

Samples analyzed 21
July 1960 to July 1961

Samples with Average count
Animals per liter
per sample

Rotifers.	19	242.2
Keratella	14	84.
Polyarthra	13	52.
Brachionus	4	33.
Synchaeta	12	11.
Other genera	17	85.

Crustaceans:		
nauplii	10	23.
copepods	8	7.
cladocerans	3	4.
Nematodes		2.
Other invertebrate metazoa		0

MOST ABUNDANT
GENERAE OF ALGAE

Percent frequency of counts
150 per ml. or more
From March 1960 to May 1961

Blue-green algae
Anabaenopsis 8
Thormidium 4

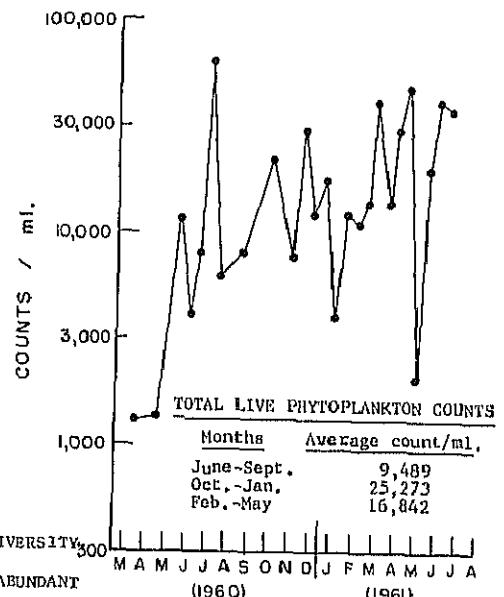
Green algae
Actinophorus 33
Anistrocladus 29
Ulothrix-type 8
Chlorococcum 4
Golenkinia 13
Microactinior 8
Scenedesmus 38
Volvella 4

Green flagellates
Chlamydomonas 79
Euglena 33
Gonium 4
Leptochlorella 8
Trachelomonas 46

Other pigmental flagellates
Chlamalina 33

Diatom
Centric
Cyclotella 50
Melosira 42
Stephanodiscus 90

Pennate
Asterionella 25
Diatoma 13
Fragilaria 4
Gomphonema 4
Invicula 13
Nitzschia 50
Surirella 8
Synedra 33

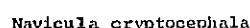
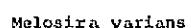
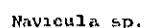
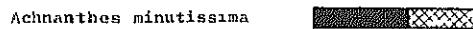
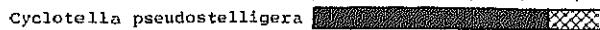


Months Average count/ml.

June-Sept.	9,489
Oct.-Jan.	25,273
Feb.-May	16,842

(1960) (1961)

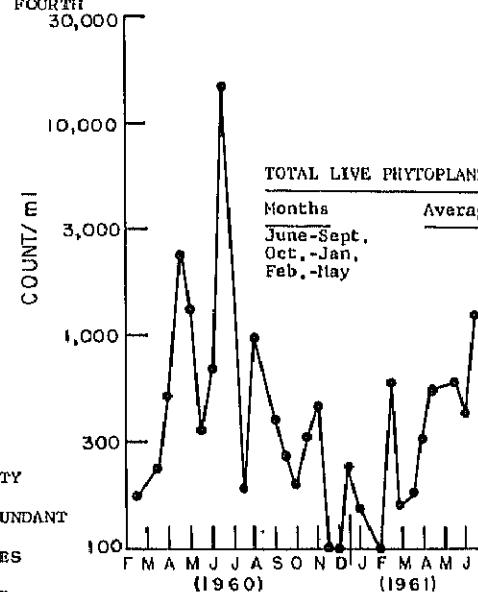
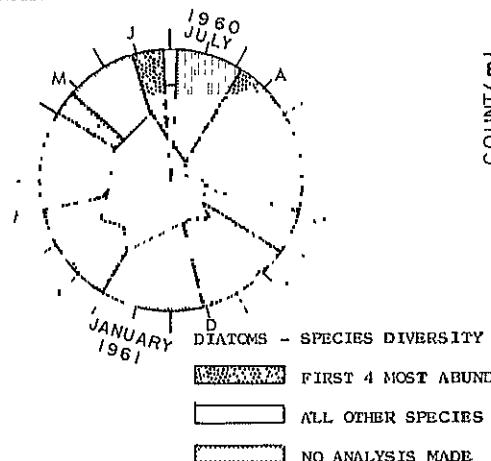
KANAWHA RIVER
WINFIELD DAM, WEST VIRGINIA



Others in first 1; species
but not in first 2

Fragilaria crotontensis

Nitzschia palea typ.



ZOOPLANKTON

Samples analyzed 21
July 1960 to July 1961

Samples with Animals	Average count per liter per sample
5	6.1
1	0.1
1	0.1
2	0.1
0	0
2	5.8

Crustacea:

Nauplii	0	0
Copepods	0	0
Cladocera	0	2

Nematodes

Other invertebrate metazoans

HOST ABUNDANT
GENERA OF ALGAI

Percent frequency of counts
150 per ml. or more

From February 1960 to May 1961

Green algae	
<i>Ankistrodesmus</i>	7
<i>Chlorococcum</i>	3
<i>Scenedesmus</i>	3
<i>Stigeoclonium</i>	3

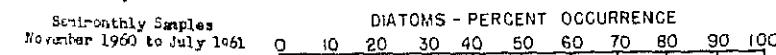
Green flagellates

Other pigmented Flagellates
Chromulina 3

Diatoms
Centric
Cyclotella 15
Stephanodiscus 7

KLAMATH RIVER
KENO, OREGON

Semi-monthly Samples
November 1960 to July 1961



Stephanodiscus hantzschii

Fragilaria construens

Fragilaria brevistriata

Synedra ulna

Others in first 4 species
but not in first 2

Fragilaria capucina

Melosira ambigua

Microcystis lanceolata group

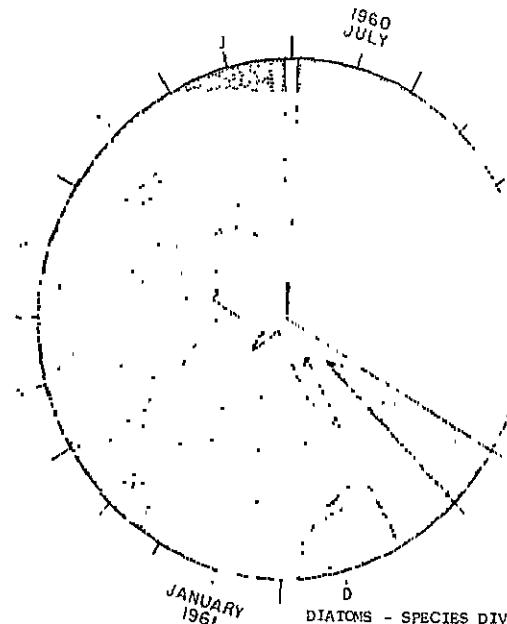
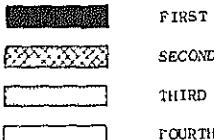
Stephanodiscus dubius

Stephanodiscus niagarae

Stephanodiscus niagarae var. *magnifica*

Stephanodiscus sp.

RELATIVE ABUNDANCE



FIRST 4 MOST ABUNDANT

ALL OTHER SPECIES

ZOOPLANKTON

Samples analyzed 18
Nov. 1960 to August 1961

Samples with Animals	Average count per liter per sample
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ROTIFERS	18	161.3
Keratella	17	39.8
Polyarthra	13	39.8
Brachionus	14	28.2
Synchaeta	10	2.1
Other genera	15	51.4

Crustaceans.		
nauplii	8	7.8
copepods	7	2.9
cladocerans	4	2.3

Nematodes	0
Other invertebrate metazoans	0

MOST ABUNDANT
GENERA OF ALGAE

Percent frequency of counts
150 per ml. or more
From Nov. 1960 to August 1961

Blue-green algae
Anacystis 16
Phormidium 5

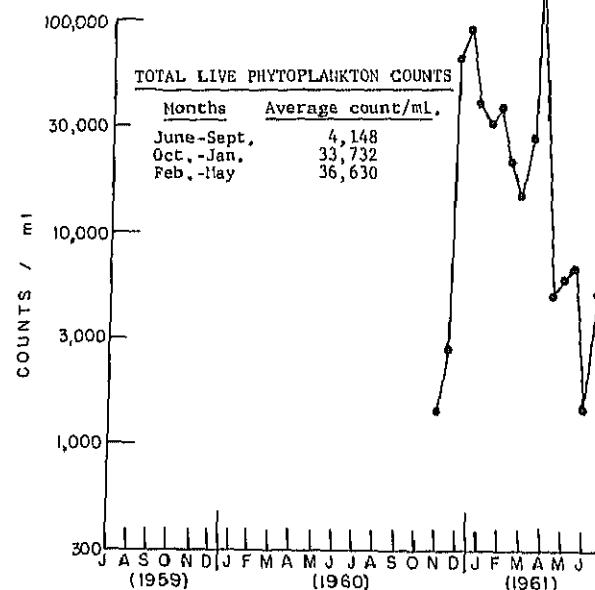
Green algae
Dictyosphaerium 11
Scenedesmus 11

Green flagellates
Chlamydomonas 5
Trachelomonas 27

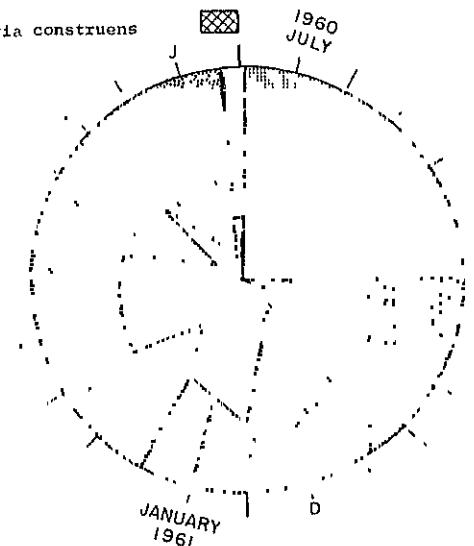
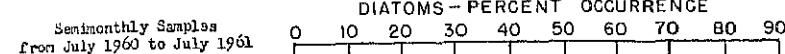
Other pigmented flagellates
Chromulina 11

Diatoms
Centric
Cyclotella 11
Melosira 5
Stephanodiscus 100

Pennate
Asterionella 5
Cymbella 5
Diatoma 6
Fragilaria 61
Navicula 15
Nitzschia 27
Surirella 5
Synedra 16



LITTLE MIAMI RIVER
CINCINNATI, OHIO



DIATOMS - SPECIES DIVERSITY

■ FIRST 4 MOST ABUNDANT

■ ALL OTHER SPECIES

■ NO ANALYSIS MADE

ZOOPLANKTON

Samples analyzed 20
July 1960 to July 1961

Samples with
Average count
Animals per liter
per sample

Rotifers:	12	85.2
Keratella	4	4.0
Polyarthra	1	0.1
Brachionus	3	59.5
Synchaeta	4	1.4
Others	9	20.2

Crustacea:		
Nauplii	2	0.7
Copepods	0	0
Cladocera	0	0

Nematodes	1	
Other invertebrate metazoans	0	

MOST ABUNDANT
GENERA OF ALGAE

Percent frequency of counts
150 per ml. or more
October 1960 to September 1961

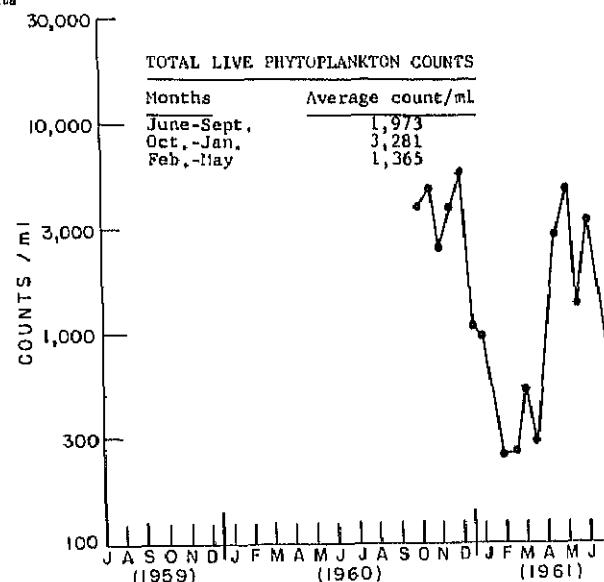
Green algae
Lagerheimia 5
Oocystis 5

Green flagellates
Chlamydomonas 20
Phacus 5
Trachelomonas 15

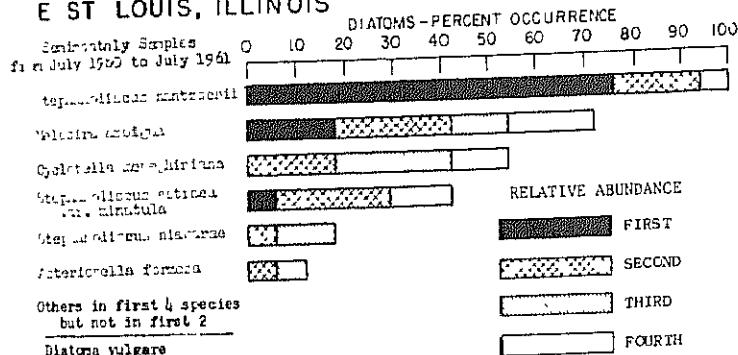
Other pigmented flagellates
Chrysococcus 5

Diatoms
Centric
Cyclotella 35
Melosira 5
Stephanodiscus 45

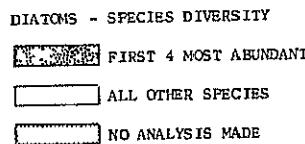
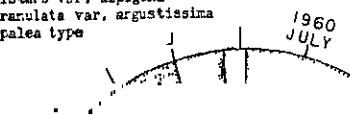
Pennate
Diatoma 10
Navicula 20
Nitzschia 20
Surirella 5
Synedra 15



MISSISSIPPI RIVER
ST LOUIS, ILLINOIS



Diatoma vulgaris
Melosira distans var. alpigena
Melosira granulata var. argustissima
Nitzschia palea type



ZOOPLANKTON

Samples analyzed 19
July 1960 to July 1961

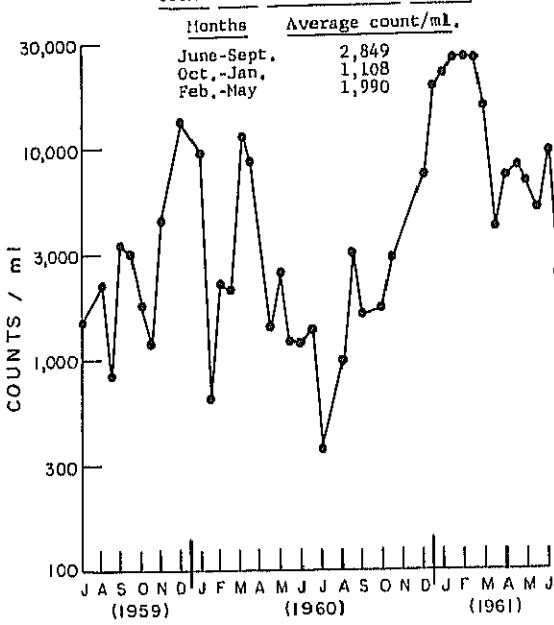
Samples with Animals	Average count per liter per sample
Rotifers	45.0
Keratella	21.0
Polyarthra	4.0
Brachionus	8.0
Synchaeta	2.0
Other genera	10.0
Crustaceans:	
nauplii	0.3
copepods	0.8
cladocerans	0.1
Nematodes	3.0
Other invertebrate metazoans	0

MOST ABUNDANT GENERA OF ALGAE

Percent frequency of counts
1% per ml. or more
From May 1959 to May 1961

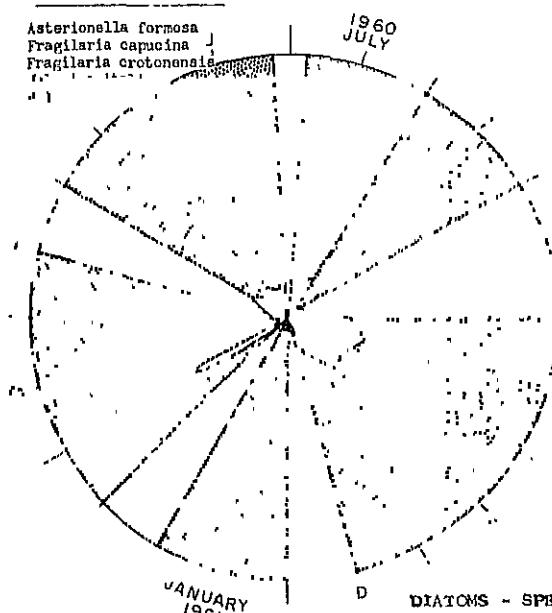
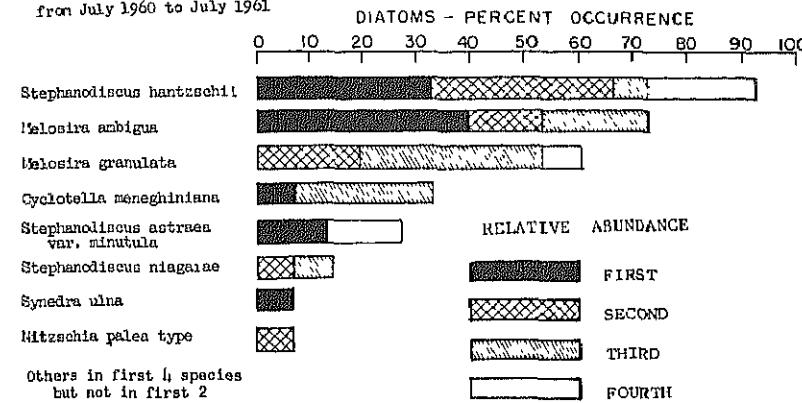
Blue-green algae	
Anacyclis	5
Green algae	
Actinastrum	2
Ankistrodesmus	5
Scenedesmus	5
Green flagellates	
Chlamydomonas	17
Thacholomonas	7
Diatoms	
Centric	
Coelosolenium	2
Cyclotella	38
Melosira	67
Stephanodiscus	88
Pennate	
Asterionella	19
Gyronigma	2
Navicula	10
Mitochondria	14
Lumicella	2
Syneisira	38

TOTAL LIVE PHYTOPLANKTON COUNTS



MISSISSIPPI RIVER
BURLINGTON, IOWA

Semimonthly Samples
from July 1960 to July 1961



ZOOPLANKTON

Samples analyzed 18
July 1960 to July 1961

Samples with Animals	Average count per liter per sample
----------------------	------------------------------------

Rotifers:	14	18.0
Keratella	13	6
Polyarthra	10	2
Brachionus	9	8
Synchaeta	5	2
Other genera	9	0

Crustaceans,		
nauplii	4	0.3
copepods	5	0.8
cladocerans	2	0.5

Nematodes		
	2	
Other invertebrate metazoans	0	

MOST ABUNDANT
GENERA OF ALGAE

Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

Blue-green algae	
Anabaena	16
Oscillatoria	3

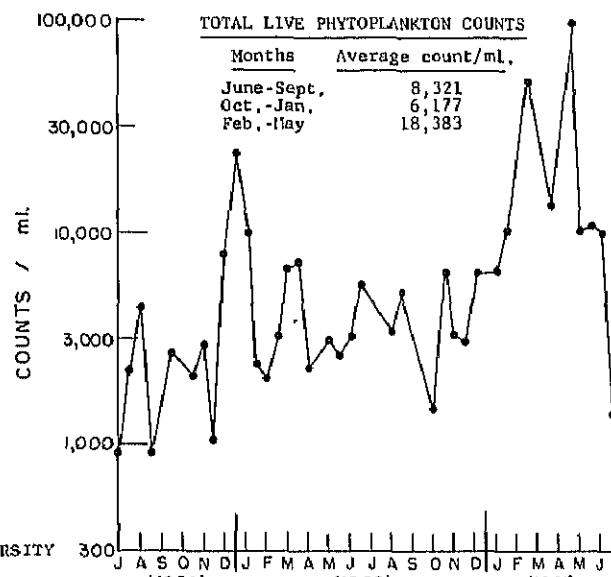
Green algae	
Actinostreum	3
Ankistrodesmus	5
Chlorella-type	5
Hirculinium	3
Oocystis	16
Scenedesmus	16
Stichococcus	3

Green flagellate algae	
Galaxydomonas	21
Phacus	3
Trachelomonas	5

Other pigmented flagellates	
Chromalina	3

Diatoms	
Centric	
Cyclotella	29
Melosira	66
Stephanodiscus	100

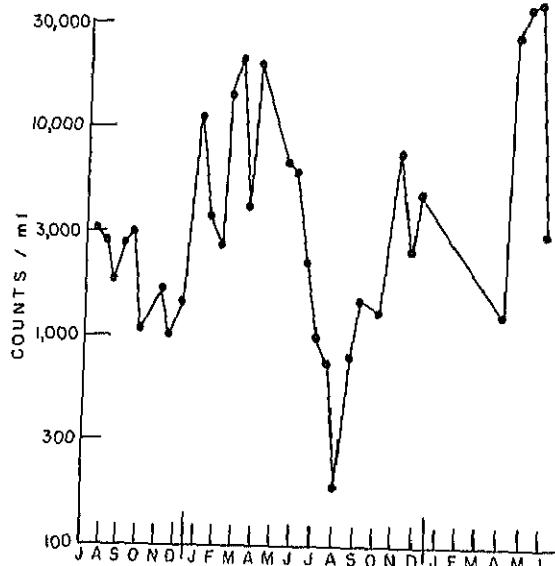
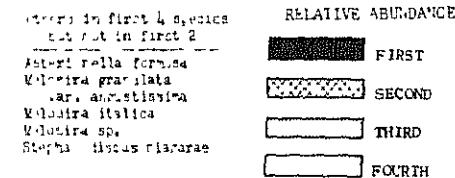
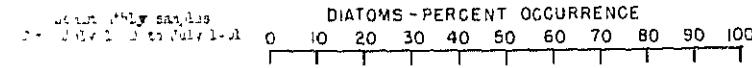
Pennate	
Asterionella	11
Cymatopleura	3
Diatoma	3
Fragilaria	5
Gyrosigma	3
Navicula	6
Nitzschia	3
Surirella	5
Synedra	29



ALL OTHER SPECIES

NO ANALYSIS MADE

MISSISSIPPI RIVER
DUBUQUE, IOWA



ZOOPLANKTON

Samples analyzed 12
July 1960 to July 1961

Samples with Animals	Average Count per liter per sample
Rotifers	42
Keratella	30
Polyarthra	2
Brachionus	5
Synchaeta	1
Other genera	4

Crustaceans:	
nauplii	5.9
copepods	3.8
cladocerans	0.5

Nematodes	1
Other invertebrate metazoa	0

MOST ABUNDANT
GENERA OF ALGAE

Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

Blue-green algae	
Anabaena	5
Anacystis	13
Aphanizomenon	8

Green algae	
chlorrella-type	
Scenedesmus	3
Schrodereria	3
Stichococcus	3

Green flagellates	
Chlamydomonas	18
Trachelomonas	3

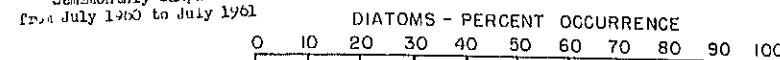
Other pigmented flagellates	
Chromulina	3

Diatoms	
Centric	
Cyclotella	5
Melosira	66
Stephanodiscus	87

Pennate	
Asterionella	5
Diatoma	3
Fragilaria	8
Navicula	5
Nitzschia	5

MISSISSIPPI RIVER
ST. PAUL, MINNESOTA

Sedimental Samples
from July 1960 to July 1961



Stephanodiscus hantzschii

Melosira ambigua

Cyclotella reneghiniensis

Asterionella formosa

Synedra ulna

Nitzschia acicularis

Fragilaria capucina

*Others in first 4 species
but not in first 2*

Cocconeis pediculus

Cyclotella atomus

Melosira sp.

Nitzschia sp.

Stephanodiscus antraea

var. *minutula*

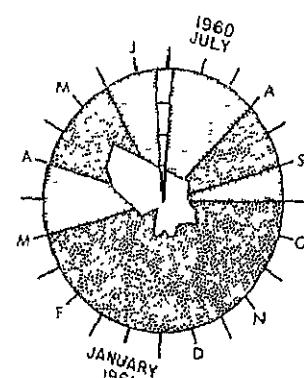
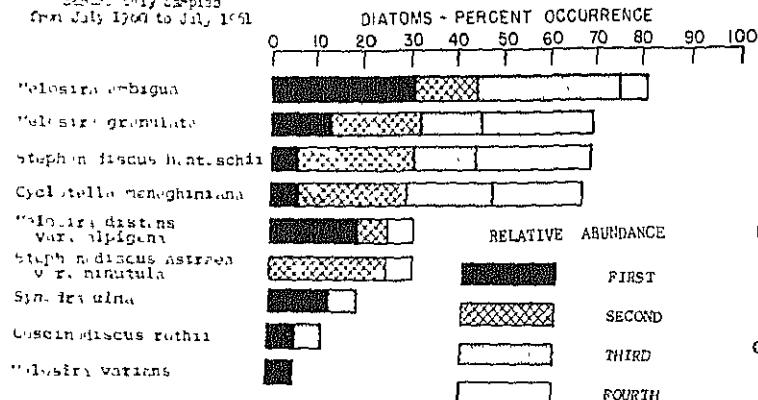
Synedra acus

S. aciculata

<

MISSISSIPPI RIVER
NEW ORLEANS, LOUISIANA

Periodically Samples
From July 1960 to July 1961



DIATOMS - SPECIES DIVERSITY

- █████ FIRST 4 MOST ABUNDANT
- _____ ALL OTHER SPECIES
- █████ NO ANALYSIS MADE

ZOOPLANKTON

Samples analyzed 24
July 1960 to July 1961

Samples with Animals	Average count per liter per sample
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	MOST ABUNDANT
<u>GENERAL</u>	
<u>Percent frequency of counts</u>	
150 per ml. or more	
From May 1959 to May 1961	
Rotifers.	6
Keratella	4
Polyarthra	1
Brachionus	2
Synchaeta	0
Other genera	3
Crustaceans	
nauplii	1
copepods	1
cladocerans	1
Nematodes	3
Other invertebrate metazoa	0

MOST ABUNDANT
GENERAL

Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

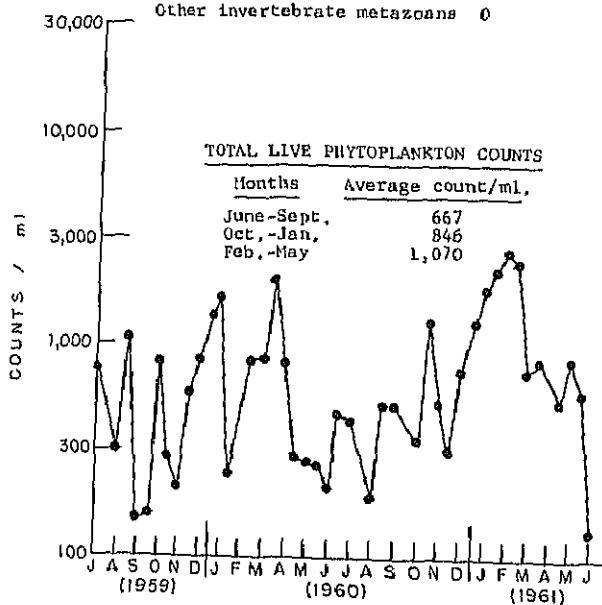
Green algae	
chlorella-type	2
<i>Scenedesmus</i>	2
<u>DIATOMS</u>	
Centric	
<i>Cyclotella</i>	9
<i>Melosira</i>	47
<i>Stephanodiscus</i>	51

Pennate
Synedra 4

TOTAL LIVE PHYTOPLANKTON COUNTS

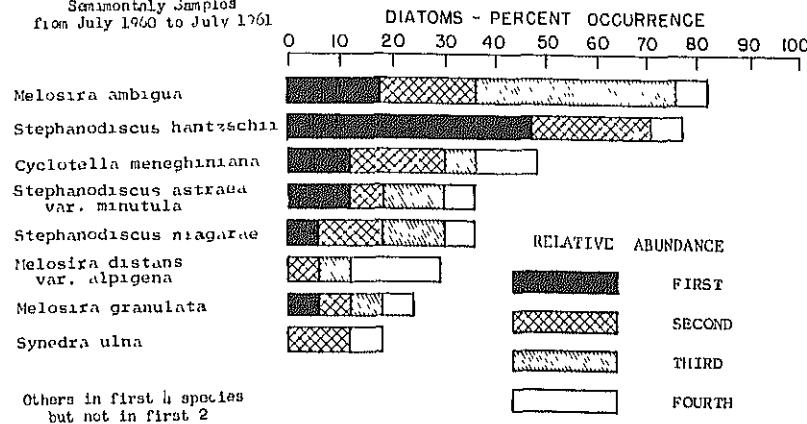
Months	Average count/ml.
--------	-------------------

June-Sept.	667
Oct.-Jan.	846
Feb.-May	1,070

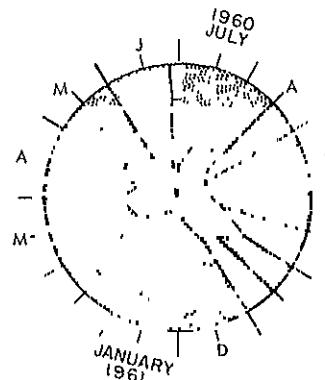


MISSISSIPPI RIVER
DELTA, LOUISIANA

Sedimental Samples
from July 1960 to July 1961



Coscinodiscus rothii
Melosira italica
Melosira varians
Wittschia palea type
Synedra acus



DIATOMS - SPECIES DIVERSITY

■ FIRST 4 MOST ABUNDANT
□ ALL OTHER SPECIES
■ NO ANALYSIS MADE

ZOOPLANKTON

Samples analyzed 20
July 1960 to July 1961

	Samples with Animals	Average count per liter per sample
Rotifers	6	0.8
Keratella	4	0.4
Polyarthra	1	0.1
Brachionus	2	0.3
Synchaeta	0	0
Other genera	2	0
Crustaceans.		
nauplii	2	0.2
copepods	3	0.3
cladocerans	0	0
Nematodes		6.
Other invertebrate metazoans	0	

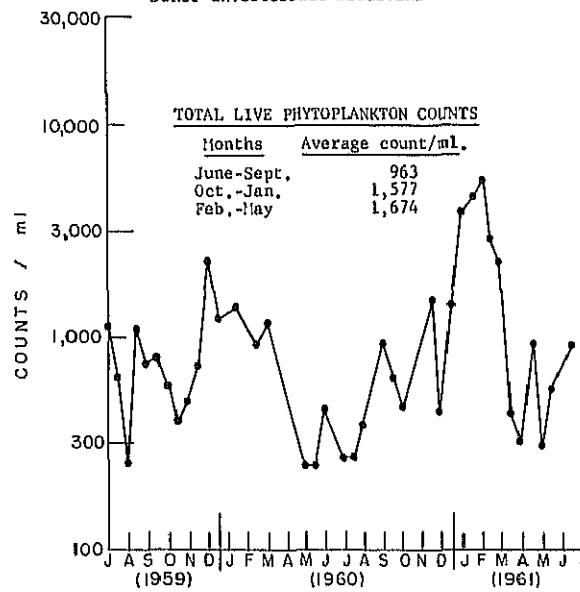
MOST ABUNDANT
GENERA OF ALGAE

Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

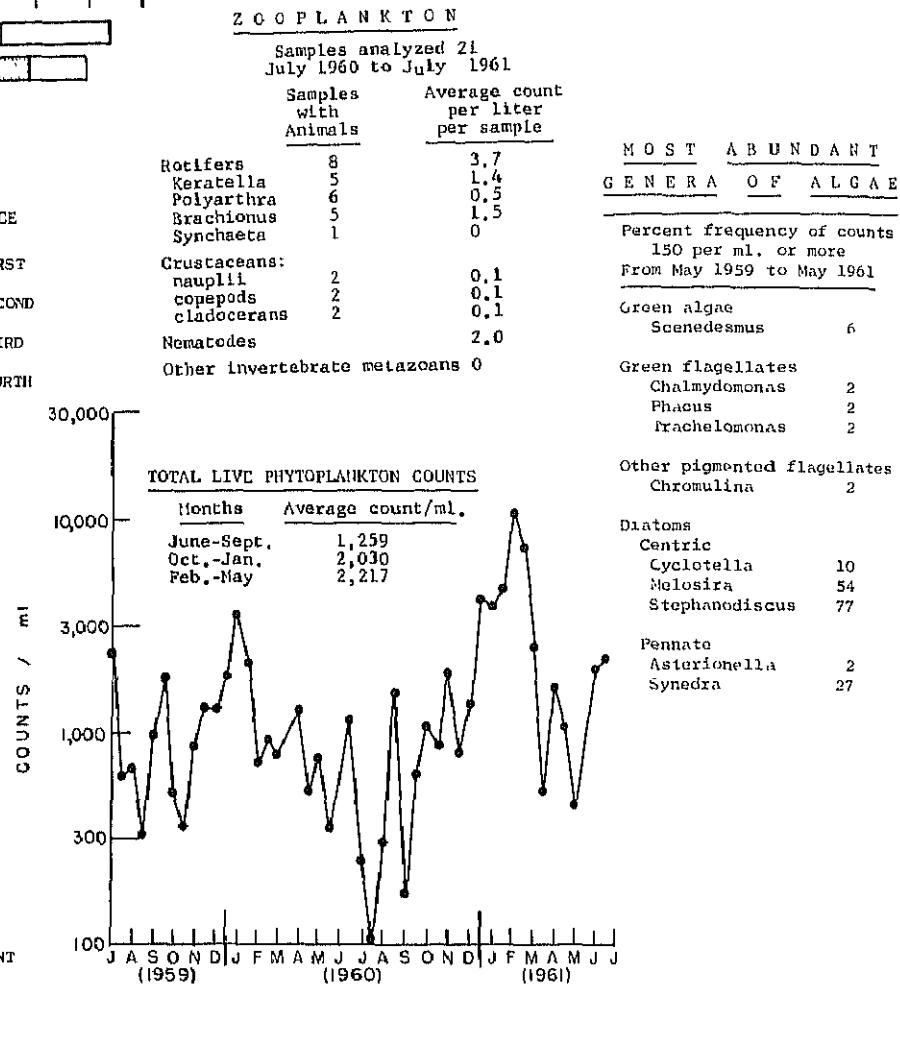
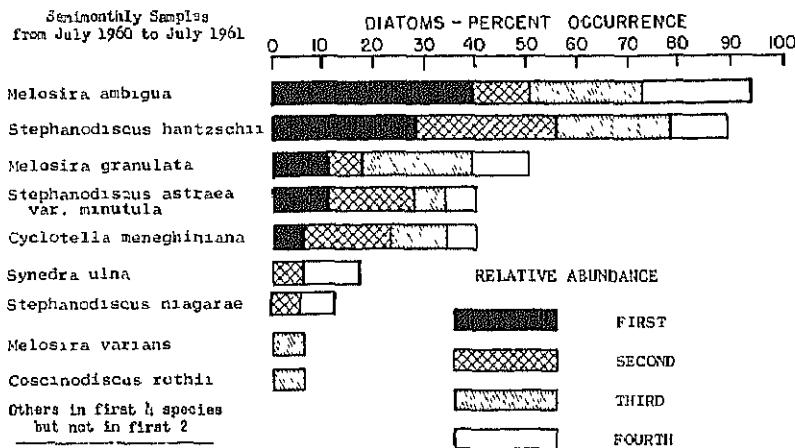
Green flagellates
Chlamydomonas 3

Diatoms
Centric 7
Cyclotella 44
Melosira 67
Stephanodiscus

Pennate
Fragilaria 3
Synedra 15



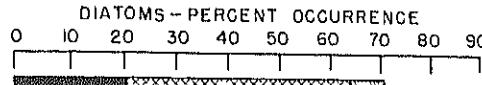
MISSISSIPPI RIVER
WEST MEMPHIS, ARKANSAS



MISSISSIPPI RIVER
CAPE GIRARDEAU, MISSOURI

Semimonthly Samples
from July 1960 to July 1961

Meiosira ambigua



Stephanodiscus hantzschii

Stephanodiscus astraea var. *minutula*

Stephanodiscus niagarae

Fragilaria constituens

Meiosira granulata

Surirella ovata

Cyclotella meneghiniana

Synedra ulna

Gyrosigma kutzningii

Nitzschia sp.

RELATIVE ABUNDANCE

FIRST

SECOND

THIRD

FOURTH

Others in first 4 species
but not in first 2

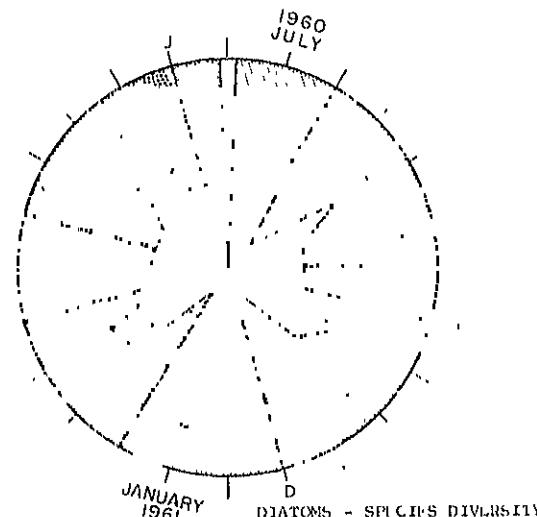
Coscinodiscus rothii

Meiosira sp.

Nitzschia linearis

Nitzschia palea type

Surirella brightwellii



■ FIRST 4 MOST ABUNDANT

■ ALL OTHER SPECIES

■ NO ANALYSIS MADE

ZOOPLANKTON

Samples analyzed 19
July 1960 to July 1961

Samples with
Average count
Animals per liter
per sample

Rotifers	7	2.8
Keratella	4	1.0
Polyarthra	4	0
Brachionus	6	1.2
Synchaeta	2	0
Other genera	3	0.8

Crustaceans:

nauplii

copepods

cladocerans

Nematodes

Other invertebrate metazoans

H O S T A B U N D A N T

G E N E R A O F A L G A E

Percent frequency of counts

150 per ml or more

From May 1959 to May 1961

Green algae

Scenedesmus 7

Tetradesmus 2

Green flagellates

Chlamydomonas 5

Other pigmented flagellates

Chromulina 2

Diatoms

Centric

Cyclotella 20

Meiosira 39

Stephanodiscus 73

Pennate

Asterionella 5

Diatoma 2

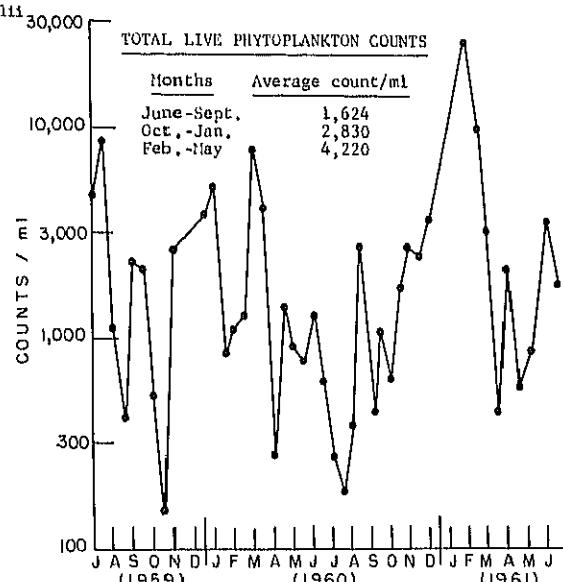
Gyrosigma 2

Navicula 2

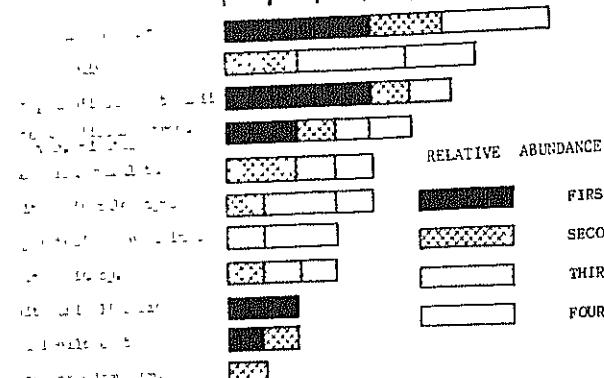
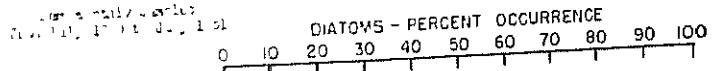
Nitzschia 5

Surirella 7

Synedra 20



MISSOURI RIVER
ST. LOUIS, MISSOURI



Others in first 4 species
Others in first 2

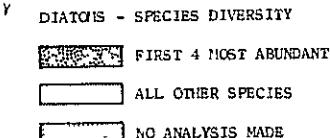
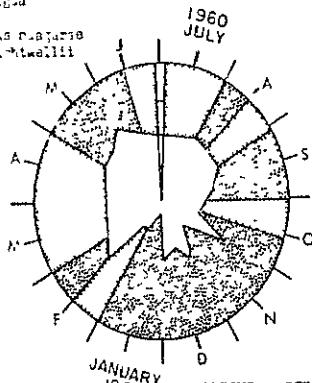
Centrocerasaria

Leptoceratia

Navicula sp.

Staurosira majorissima

Spirula triquetrella



ZOOPLANKTON

Samples analyzed 23
July 1960 to July 1961

Samples with Animals	Average count per liter per sample
Rotifers.	0
Keratella	0
Polyarthra	0
Brachionus	0
Synchaeta	0
Other genera	1
Crustaceans:	
nauplii	1
copepods	3
cladocerans	0
Nematodes	2
Other invertebrate metazoans	0

MOST ABUNDANT GENERA OF ALGAE

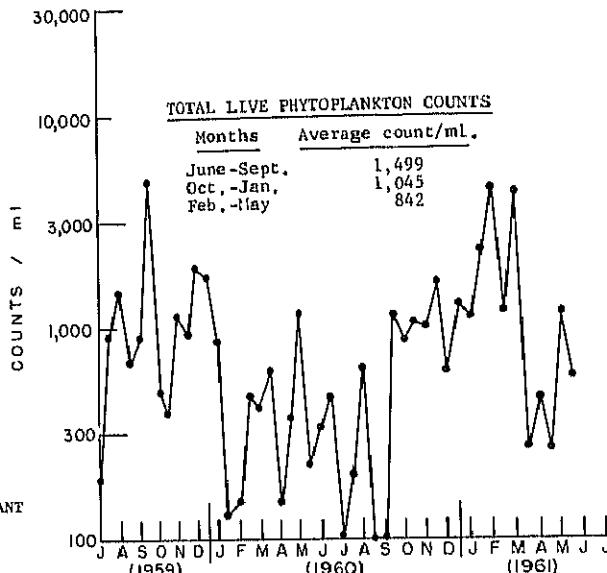
Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

Green algae
Ankistrodesmus 2
Scenedesmus 4

Green flagellates
Chlamydomonas 4
Trachomonas 2

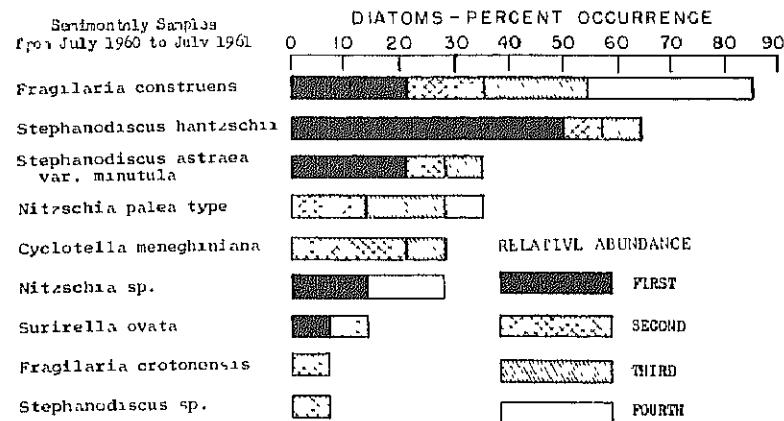
Diatoms
Centric 6
Cyclotella 6
Melosira 6
Stephanodiscus 53

Leptoflagellates
Asterionella 4
Praegularia 2
Gonyaulax 2
Navicula 2
Synedra 23



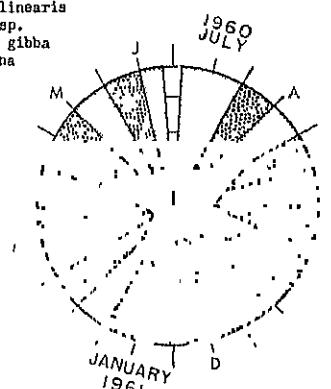
MISSOURI RIVER
KANSAS CITY, KANSAS

Semimonthly Samples
from July 1960 to July 1961

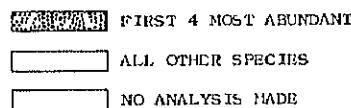


Others in first 4 species
but not in first 2

Amphipora paludosa
Fragilaria capucina
Nitzschia acicularis
Nitzschia linearis
Nitzschia sp.
Rhopalodia gibba
Synedra ulna



DIATOMS - SPECIES DIVERSITY



ZOOPLANKTON

Samples analyzed 18
July 1960 to July 1961

Samples with
Average count
Animals per liter
per sample

Rotifers	0	0
Keratella	0	0
Polyarthra	0	0
Brachionus	0	0
Synchaeta	0	0
Others	0	0
Crustacea:		
nauplii	0	0
Copepods	0	0
Cladocera	0	0
Nematodes	0	2
Other invertebrate metazoan	0	

MOST ABUNDANT
GENERA OF ALGAE

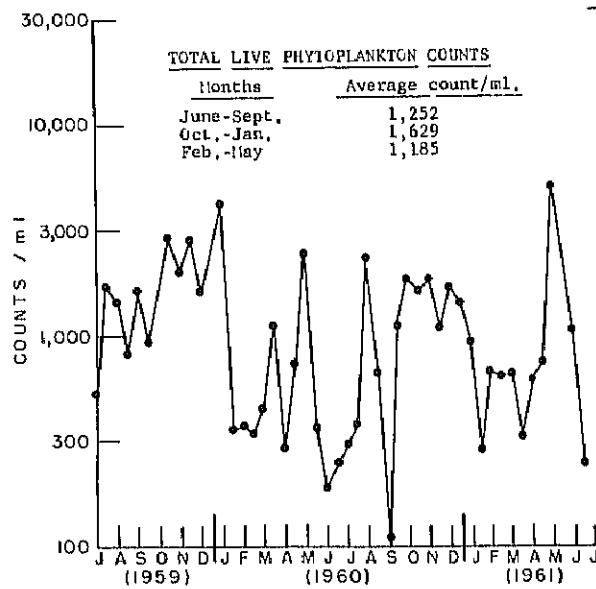
Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

Green algae
Ankistrodesmus 2
Scenedesmus 13

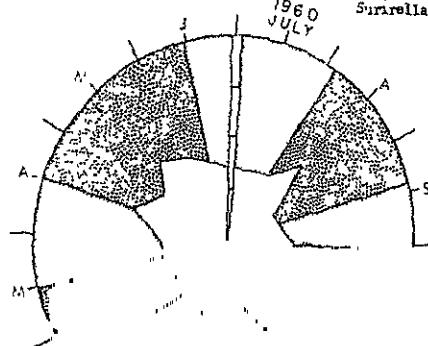
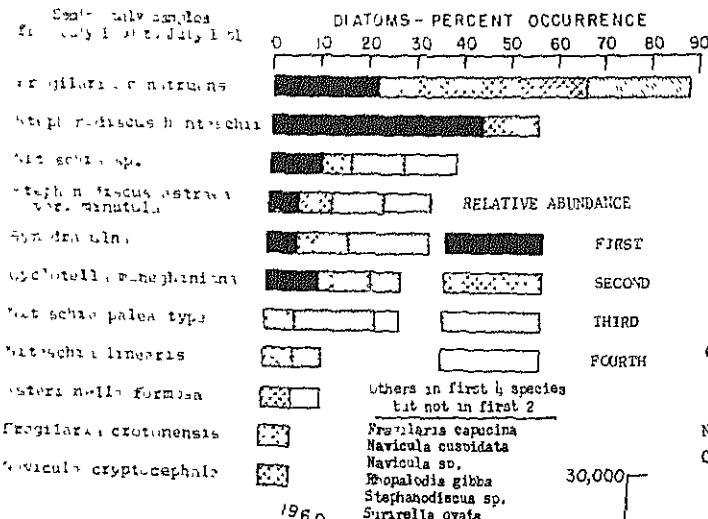
Green Flagellates
Chlamydomonas 17
Phacus 2
Trachelomonas 2

Diatoms
Centric
Cyclotella 13
Melosira 9
Stephanodiscus 57

Pennate
Asterionella 6
Fragilaria 11
Gomphonema 2
Navicula 6
Nitzschia 11
Surirella 4
Synedra 21

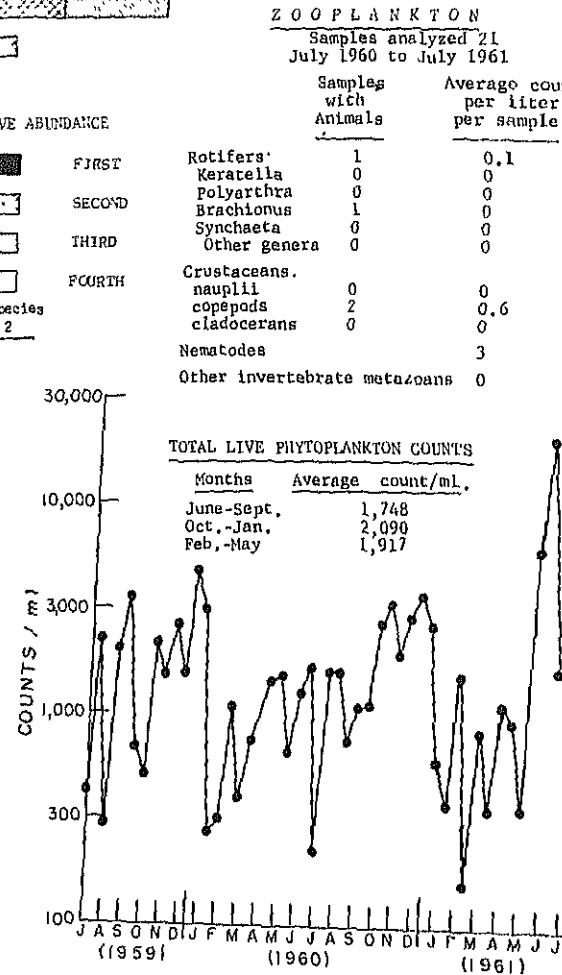


MISSOURI RIVER
ST JOSEPH, MISSOURI



DIATOMS - SPECIES DIVERSITY

FIRST 4 MOST ABUNDANT



MOST ABUNDANT
GENERAL OF ALGA

Percent frequency of counts
150 per ml. or more
from May 1959 to May 1961

Blue-green algae
Anacystis 2

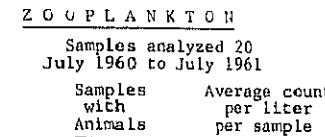
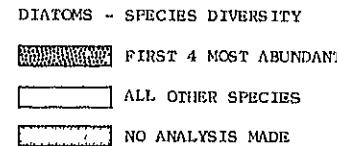
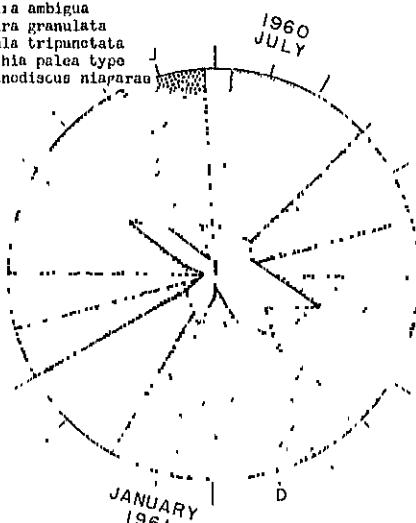
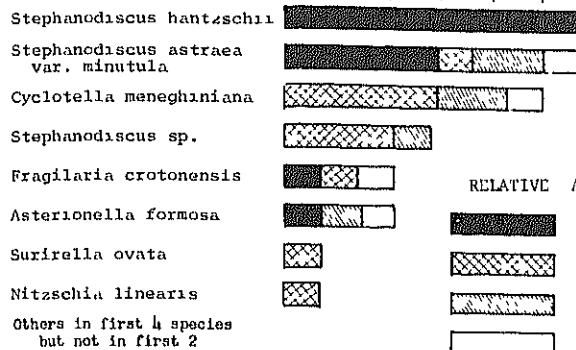
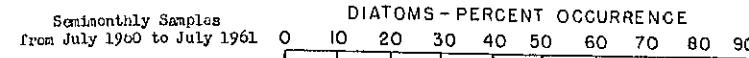
Green algae	
Actinostrium	2
Ankistrodesmus	6
Scenedesmus	14

Green flagellates	
Chlamydomonas	16
Euglena	2
Trachelomonas	10

Diatoms	
Centric	
Cyclotella	18
Melosira	16
Stephanodiscus	73

Pennata	
Asterionella	14
Fragilaria	16
Navicula	4
Nitzschia	16
Synechra	22

MISSOURI RIVER
OMAHA, NEBRASKA



	Samples with Animals	Average count per liter per sample
Crustaceans.		
nauplii	2	0.3
copepods	5	0.5
cladocerans	1	0.1
Nematodes		3
Other invertebrate metazoans		0

MOST ABUNDANT
GENERA OF ALGAE

Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

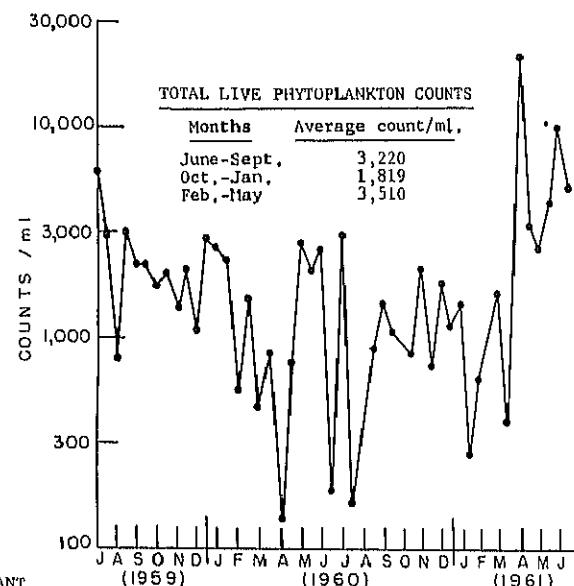
Green algae	
Ankistrodesmus	7
chlarella-type	2
Oocystis	2
Scenedesmus	11
Selenastrum	2
Stichococcus	2

Green flagellates	
Chlamydomonas	24
Trachelomonas	7

Other pigmented flagellates	
Chrysococcus	2

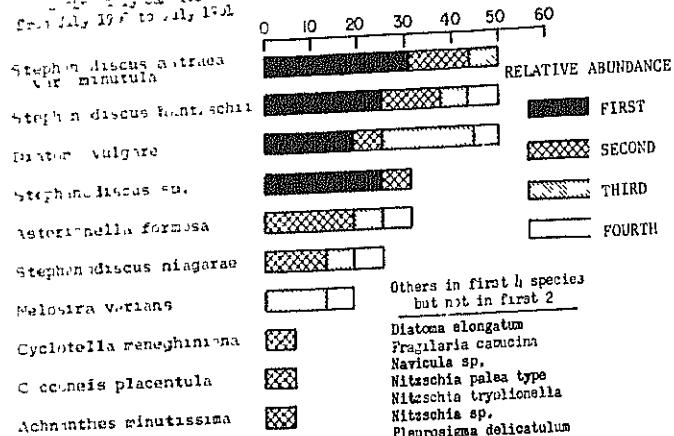
Diatoms	
Centric	
Cyclotella	7
Melosira	17
Stephanodiscus	85

Pennate	
Asterionella	22
Diatoma	2
Navicula	2
Nitzschia	17
Surirella	7
Synedra	22



MISSOURI RIVER
YANKTON, SOUTH DAKOTA

for July 1959 to July 1961



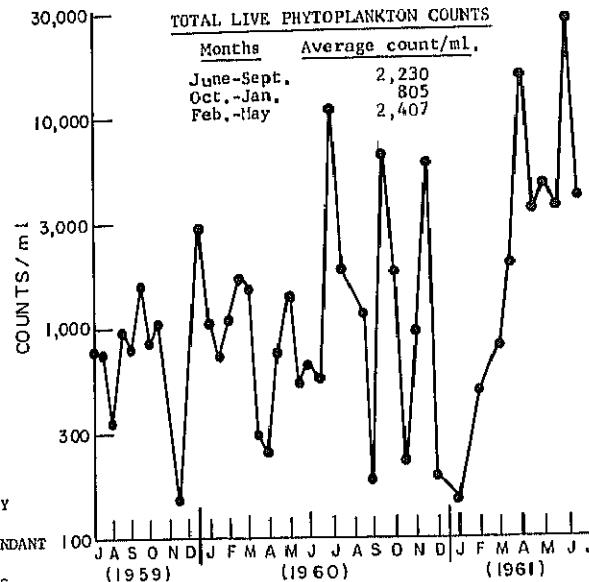
1960
JULY

1961
JANUARY

DIATOMS - SPECIES DIVERSITY

FIRST 4 MOST ABUNDANT

ALL OTHER SPECIES



ZOOPLANKTON

Samples analyzed 74
July 1960 to July 1961

	Samples with Animals	Average count per liter per sample
Rotifers.	16	27.3
Keratella	8	20.9
Polyarthra	6	1.5
Brachionus	4	0.6
Synchaeta	6	2.0
Other genera	11	2.3
Crustaceans.		
nauplii	10	3.9
copepods	10	6.5
cladocerans	3	2.0
Nematodes		0
Other invertebrate metazoans		0

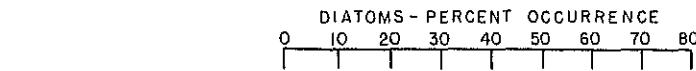
MOST ABUNDANT
GENERA OF ALGAE

Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

Blue-green algae	
Anacystis	2
Green algae	
Ankistrodesmus	7
chlorrella-type	4
Scenedesmus	4
Selenasirum	1
Green flagellates	
Chlamydomonas	11
Euglena	2
Trachelomonas	13
Other pigmented flagellates	
Gymnodinium	2
Diatoms	
Centric	
Cyclotella	4
Melosira	2
Stephanodiscus	72
Pennate	
Asterionella	26
Cocconeis	2
Cymbella	4
Diatoma	11
Gomphonema	2
Navicula	4
Nitzschia	9
Pleurosigma	2
Synedra	9

MISSOURI RIVER
BISMARCK, NORTH DAKOTA

Semimonthly Samples
from July 1960 to July 1961

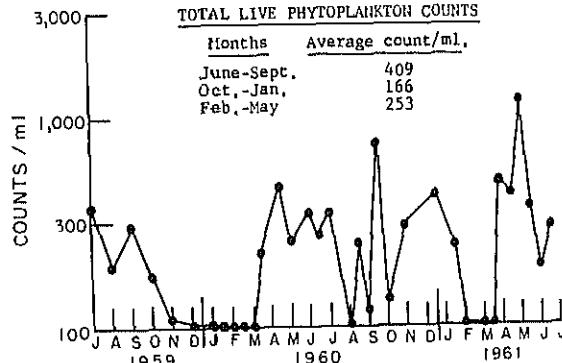
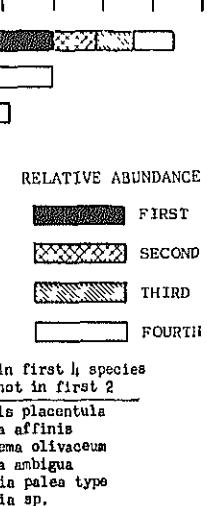
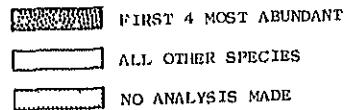


JULY
1960

M A

JANUARY
1961

DIATOMS - SPECIES DIVERSITY

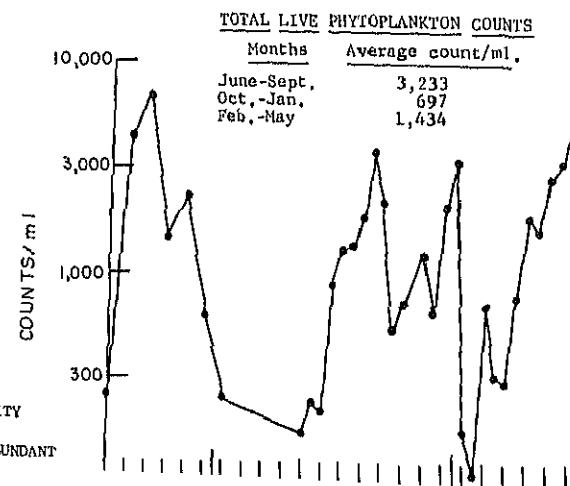
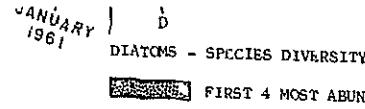
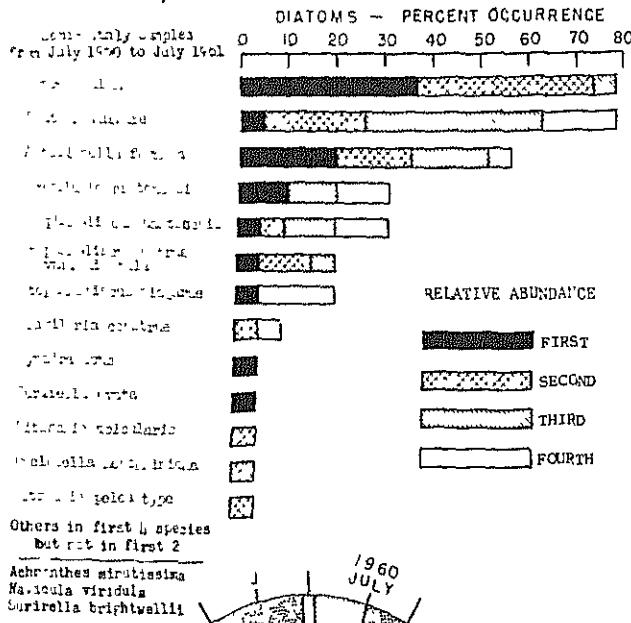


MOST ABUNDANT
GENERA OF ALGAE

Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

Diatoms	
Centric	
Stephanodiscus	9
Pennate	
Asterionella	3
Synedra	6

MISSOURI RIVER
WILLISTON, NORTH DAKOTA



ZOOPLANKTON

Samples analyzed 24
July 1960 to July 19

	Samples with Animals	Average count per liter per sample
Rotifers.	8	0.9
Keratella	1	0
Polyarthra	1	0
Brachionus	1	0
Synchaeta	1	0
Other genera	3	0
Crustaceans.		
nauplii	1	0
copepods	3	0.5
cladocerans	0	0
Nematodes		1
Other metazoan invertebrates		none

M O S T A B U N D A N T
G E N E R A O F A L G A

Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

Blue-green algae	
Anacystis	6
Aphanizomenon	3
Green algae	
Actinostroma	3
Ankistrodesmus	3
Oocystis	3
Scenedesmus	3

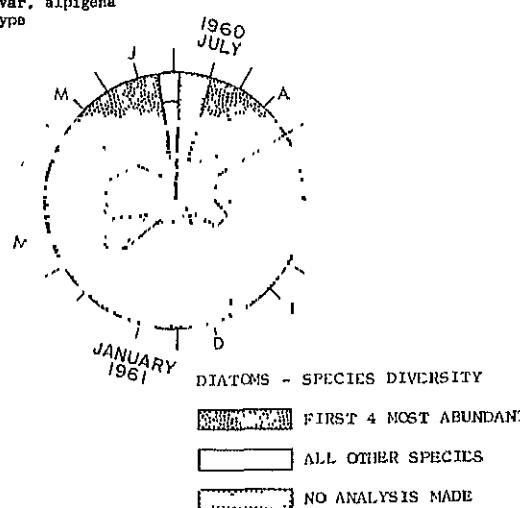
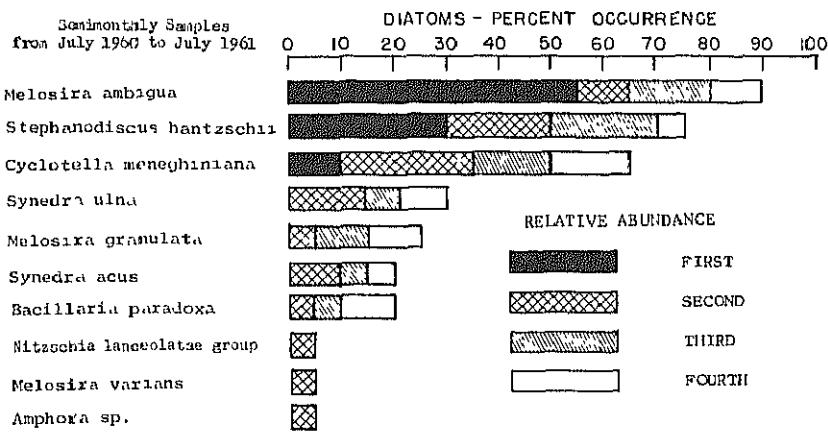
Green flagellates
Chlamydomonas 6
Frachclomonas 6

Diatom
Centric
Cyclotella 8
Stephanodiscus 47

Pennula	
Asteroionella	36
Cymbella	6
Diatoma	22
Fragilaria	17
Navicula	29
Neitzschia	25
Curvella	3
Synedra	14

OHIO RIVER
CAIRO, ILLINOIS

Scanningly Samples
from July 1960 to July 1961



ZOOPLANKTON

Samples analyzed 24
July 1960 to July 1961

	Samples with Animals	Average count per liter per sample
Rotifers	9	3.0
Keratella	6	2.0
Polyarthra	1	0
Brachionus	5	1.0
Synchaeta	1	0
Other genera	3	0
Crustaceans:		
nauplii	0	0
copepods	1	0.1
cladocerans	8	0.6
Nematodes		2.0
Other invertebrate metazoans		0

MOST ABUNDANT GENERA OF ALGAE

Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

Blue-green algae
Anacystis

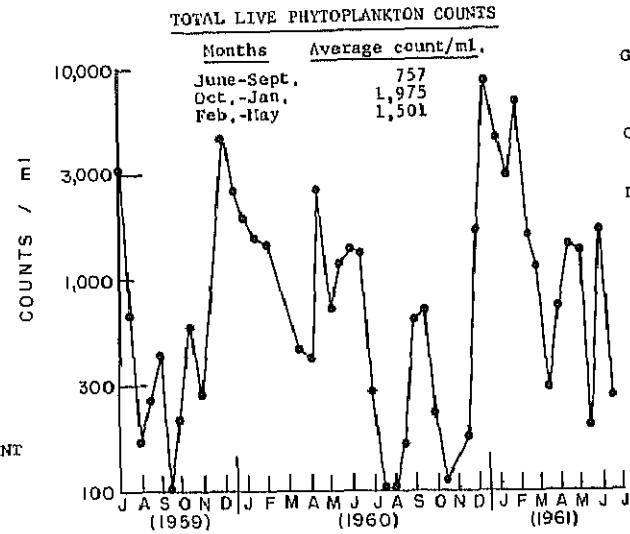
Green algae	
<i>Ankistrodesmus</i>	4
<i>chlorrella-type</i>	2
<i>Scenedesmus</i>	4
<i>Stichococcus</i>	2

Green flagellates
 Chlamydomonas 2
 Trachelomonas 2

Other pigmented flagellates

Diatoms	
Centric	
Cyclotella	38
Melosira	40
Stephanodiscus	22

Pennate	
Gemphonema	4
Nitzschia	2
Synedra	32



OHIO RIVER
EVANSVILLE, INDIANA

Minimally samples
from July 1959 to July 1961

Melosira ambigua

Symedra ulna

Melosira granulata

Symedra coccus

Cyclotella meneghiniana

Stephanodiscus hantzschii

Melosira distans

v. r. *alpigena*

Asterionella formosa

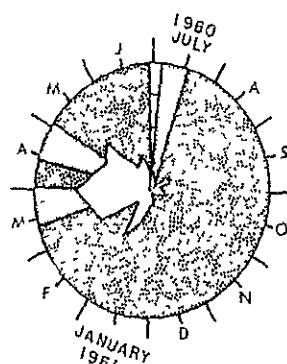
Others in first 4 species
but not in first 2

Cymatopleura solea

Diatoma vulgaris

Fragilaria crotonensis

Surirella ovata

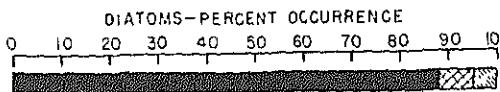


DIATOMS - SPECIES DIVERSITY

FIRST 4 MOST ABUNDANT

ALL OTHER SPECIES

NO ANALYSIS MADE



ZOOPLANKTON

Samples analyzed 21
July 1960 to July 1961

Samples with Animals	Average count per liter per sample
-------------------------	--

M O S T A B U N D A N T
G E N E R A O F A L G A E

Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

Blue-green algae	
Anabaena	3
Anacyclis	15
Aphanizomenon	4
Oscillatoria	6

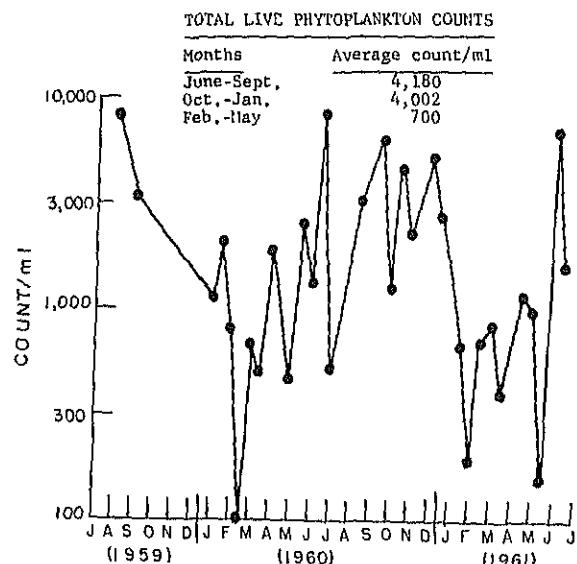
Green algae	
Actinostrom	3
Antistreptidemus	4
Dictyosphaerium	3
Golenkinia	3
Micractinium	3
Oocystis	3
Radiococcus	3
Scenedesmus	15
Spirogyra	3
Tetradesmus	3
Tetrasium	3
Ulothrix	4
Westella	3

Green flagellates	
Chlamydomonas	9
Trachelomonas	3

Other pigmented flagellates	
Chromulina	9

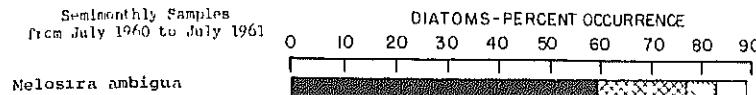
Diatoms	
Centric	
Cyclotella	3
Melosira	70
Stephanodiscus	36

Pennate	
Asterionella	9
Comphonema	3
Navicula	3
Surirella	3
Synedra	48



OHIO RIVER
CINCINNATI, OHIO

Seminonthly Samples
from July 1960 to July 1961



Melosira ambigua

Melosira granulata

Synedra acus

Cyclotella meneghiniana

Synedra ulna

Stephanodiscus hantzschii

Melosira varians

Synedra nana

Surirella ovata

Fragilaria crotonensis

Others in first 4 species
but not in first 2

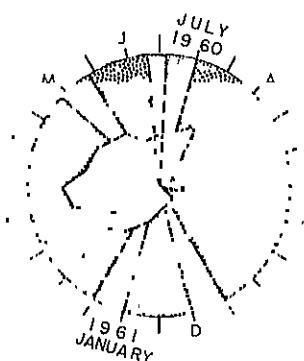
Gomphonema parvulum

Gyrosigma kutzinigii

Melosira distans var. *alpigena*

Hantzschia pales type

Pinnularia sp.



DIATOMS - SPECIES DIVERSITY

FIRST 4 MOST ABUNDANT

ALL OTHER SPECIES

NO ANALYSIS MADE

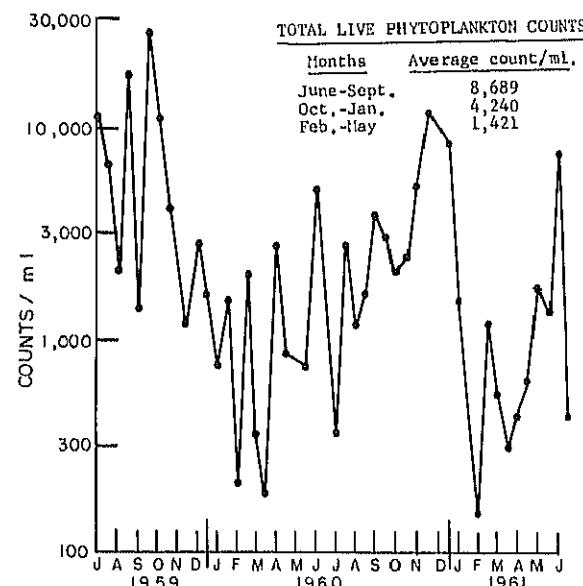
RELATIVE ABUNDANCE

FIRST
 SECOND
 THIRD
 FOURTH

ZOOPLANKTON

Samples analyzed 21
July 1960 to July 1961

	Samples with Animals	Average count per liter per sample
Rotifers.	12	58.0
Keratella	10	39.7
Polyarthra	10	5.6
Brachionus	9	6.6
Synchaeta	4	3.5
Other genera	8	11.1
Crustaceans		
nauplii	6	1.3
copepods	6	2.0
cladocerans	7	2.0
Nematodes		2.0
Other invertebrate metazoans	0	



MOST ABUNDANT

GENERA OF ALGAE

Percent frequency of counts

150 per ml. or more

From May 1959 to May 1961

Blue-green algae

<i>Arabescia</i>	9
<i>Ancylotrichia</i>	27
<i>Aphanizomenon</i>	9
<i>Arthrospira</i>	?
<i>Oscillatoria</i>	18
<i>Phormidium</i>	4
<i>Raphidiopsis</i>	2

Green algae

<i>Actinophorus</i>	4
<i>Anistrocladus</i>	13
<i>Chlorococcus</i> -type	20
<i>Chlorococcus</i>	7
<i>Dictyosphaerium</i>	1
<i>Dinophycoccus</i>	2
<i>Golenkinia</i>	1
<i>Oocystis</i>	4
<i>Palmaria</i>	2
<i>Scenedesmus</i>	27

Green flagellates

<i>Chlamydomonas</i>	20
<i>Trachelomonas</i>	11

Other pigmented flagellates

<i>Chromulina</i>	11
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Diatoms

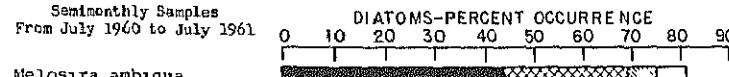
<i>Centric</i>	42
<i>Cyclotella</i>	49
<i>Melosira</i>	69
<i>Stephanodiscus</i>	18

Pennate

<i>Asterionella</i>	7
<i>Cymbella</i>	4
<i>Diatoma</i>	2
<i>Gomphonema</i>	7
<i>Navicula</i>	16
<i>Nitzschia</i>	11
<i>Synedra</i>	69

OHIO RIVER
HUNTINGTON, WEST VIRGINIA

Semimonthly Samples
From July 1960 to July 1961



Melosira ambigua
Melosira granulata

Cyclotella meneghiniana

Synedra ulna

Synedra acus

Stephanodiscus hantzschii

Melosira varians

Asterionella formosa

Diatoma elongatum

Pinnularia sp.

Others in first 4 species
but not in first 2

Cyclotella pseudostelligera

Achnanthes minutissima

Diatoma vulgare

Melosira distans
var. alpigena

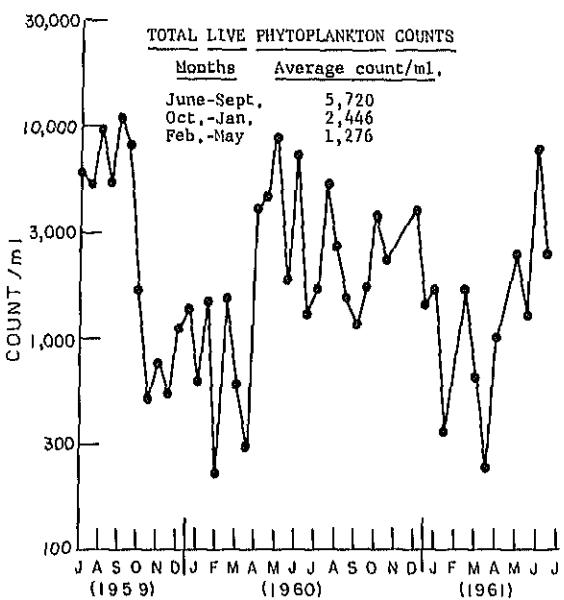
1960 JULY

JANUARY 1961

DIATOMS - SPECIES DIVERSITY

FIRST 4 MOST ABUNDANT

ALL OTHER SPECIES



ZOOPLANKTON

Samples analyzed 21
July 1960 to July 1961

	Samples with Animals	Average count per liter per sample
Rotifers	13	28
Keratella	12	20
Polyarthra	10	6
Brachionus	9	2
Synchaeta	7	1
Other genera	8	0

Crustaceans:		
nauplii	6	1.1
copepods	5	2.0
cladocerans	6	1.3
Nematodes		0
Other invertebrate metazoans		0

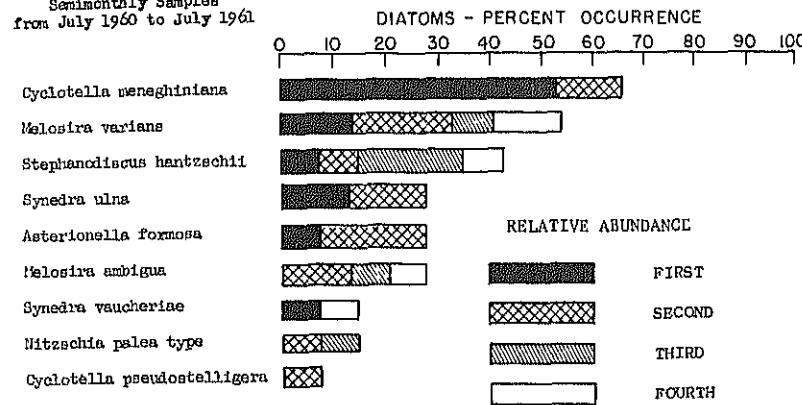
MOST ABUNDANT
GENERA OF ALGAE

Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

Blue-green algae	
Anabaena	7
Anacystis	24
Compsosphaeria	4
Oscillatoria	7
Rhaphidiopsis	2
Green algae	
Actinostrum	4
Ankistrodesmus	24
Chlorella-type	9
Coelasium	2
Dictyosphaerium	4
Golenkinia	9
Kirchneriella	2
Lagerheimia	2
Micractinium	2
Oocystis	4
Scenedesmus	36
Selenasium	2
Staurastrum	2
Tetradesmus	7
Green flagellates	
Chlamydomonas	20
Phacus	2
Trachelomonas	4
Other pigmented flagellates	
Chromalina	7
Chrysococcus	2
Diatoms	
Centric	
Cyclotella	47
Melosira	64
Stephanodiscus	20
Pennate	
Asterionella	9
Diatoma	4
Fragilaria	2
Gomphonema	2
Navicula	11
Nitzschia	11
Surirella	2
Synedra	60

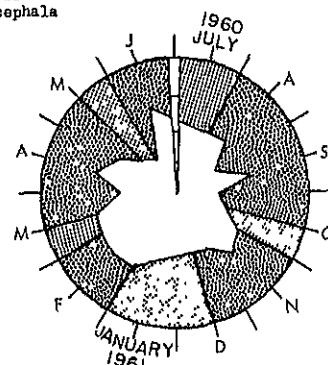
OHIO RIVER
EAST LIVERPOOL, OHIO

Semimonthly Samples
from July 1960 to July 1961



Others in first 4 species
but not in first 2

Achnanthes minutissima
Cocconeis placentula
Diatoma elongatum
Diatoma vulgare
Fragilaria capucina
Frustulula vulgaris
Navicula cryptocephala
Navicula sp.
Nitzschia sp.
Nitzschia sp.



DIATOMS - SPECIES DIVERSITY

FIRST 4 MOST ABUNDANT
ALL OTHER SPECIES
NO ANALYSIS MADE

ZOOPLANKTON

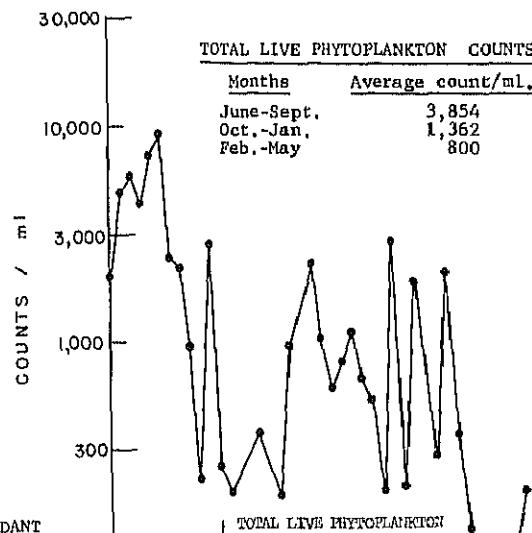
Samples analyzed 20
July 1960 to July 1961

Animals	Samples with	Average count per liter
Rotifers:	10	13.0
Keratella	5	1.0
Polyarthra	4	1.0
Brachionus	7	3.4
Synchaeta	2	3.0
Other genera	7	4.6
Crustaceans.		
nauplii	6	1.7
copepods	4	4.0
cladocerans	1	1.0
Nematodes		1.0
Other invertebrate metazoans	0	

MOST ABUNDANT
GENERA OF ALGAE

Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

Blue-green algae	
Anacyclis	13
Calothrix	2
Gomphosphaeria	9
Oscillatoria	2
Green algae	
Actinostrum	7
Ankistrodesmus	20
chlorocella-type	11
Closterium	4
Coelastrum	2
Dictyosphaerium	2
Golenkinia	4
Micractinium	2
Palmeilococcus	2
Scenedesmus	24
Tetradesmus	11
Tetraspora	2
Green flagellates	
Chlamydomonas	28
Trachelomonas	4
Other pigmented flagellates	
Chromulina	9
Diatoms	
Centric	
Cyclotella	24
Melosira	9
Stephanodiscus	9
Pennate	
Asterionella	4
Diatoma	2
Gomphonema	4
Navicula	13
Nitzschia	7
Synedra	77



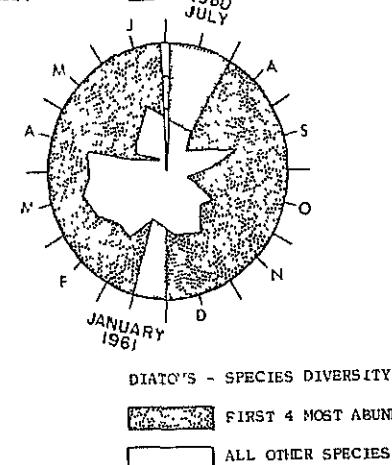
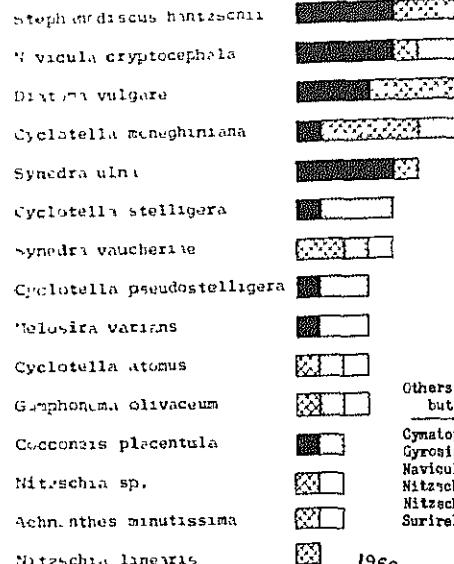
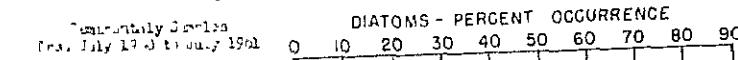
TOTAL LIVE PHYTOPLANKTON

COUNTS

100 J A S O N D J F M A M J J F M A M J J

(1959) (1960) (1961)

POTOMAC RIVER
GREAT FALLS, MARYLAND



ZOOPLANKTON

Samples analyzed 24
July 1960 to July 1961

	Samples with Animals	Average count per liter per sample
Rotifers.	7	2.9
Keratella	4	0.2
Polyarthra	2	0.2
Brachionus	2	0.1
Synchaeta	0	0
Other genera	6	2.4
Crustaceans:		
nauplii	0	0
copepods	1	0.1
cladocerans	0	0
Nematodes		3
Other invertebrate metazoans	0	

MOST ABUNDANT GENERA OF ALGAE

Percent frequency of counts
150 per ml or more
From May 1959 to May 1961

Blue-green algae	Agmenellum	6
	Anacystis	14

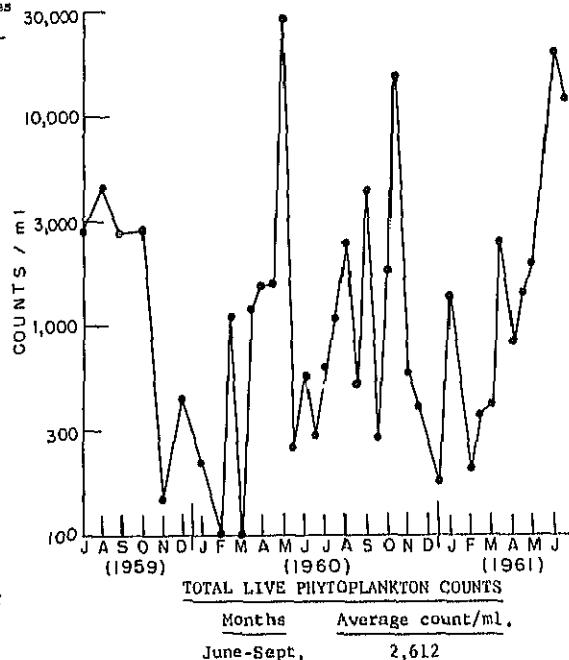
Green algae	Actinastrum	3
	Ankistrodesmus	6
	Chlorella-type	6
	Closterium	3
	Coclastrum	3
	Crucigenia	3
	Dictyosphaerium	3
	Oocystis	6
	Pediastrum	6
	Scenedesmus	28
	Staurastrum	3

Green flagellates	Chlamydomonas	11
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Other pigmented flagellates	Chromulina	6
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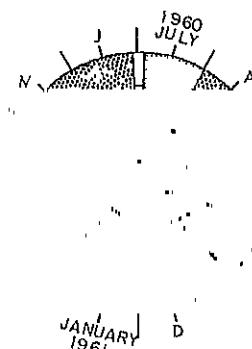
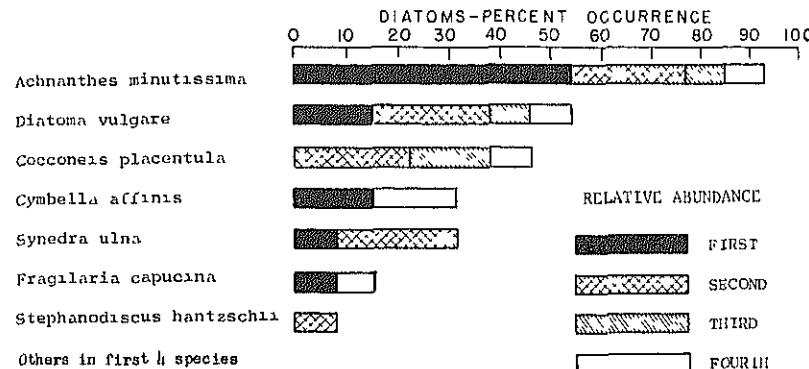
Diatoms	Centric	
	Cyclotella	28
	Melosira	6
	Stephanodiscus	28

Pennate	Cymbella	3
	Diatoma	6
	Gomphonema	3
	Navicula	17
	Nitzschia	11
	Surirella	3
	Synedra	31



POTOMAC RIVER
WILLIAMSPORT, MD.

Seasonal samples
from July 1960 to July 1961



DIATOMS - SPECIES DIVERSITY

- FIRST 4 MOST ABUNDANT
- ALL OTHER SPECIES
- NO ANALYSIS MADE

ZOOPLANKTON

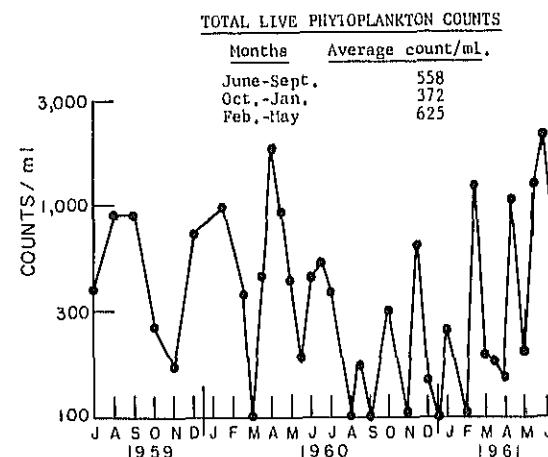
Samples analyzed 20
July 1960 to July 1961

Samples with Animals	Average count per liter per sample
Rotifers	1.4
Keratella	0
Polyarthra	0
Brachionus	0
Synchaeta	0
Other genera	1.1
Crustaceans	0.1
nauplii	1
copepods	0
cladocerans	0.1
Nematodes	0
Other invertebrate metazoans	0

MOST ABUNDANT
GENERA OF ALGAE

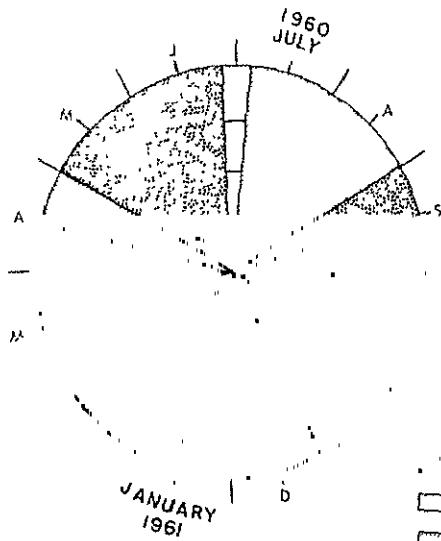
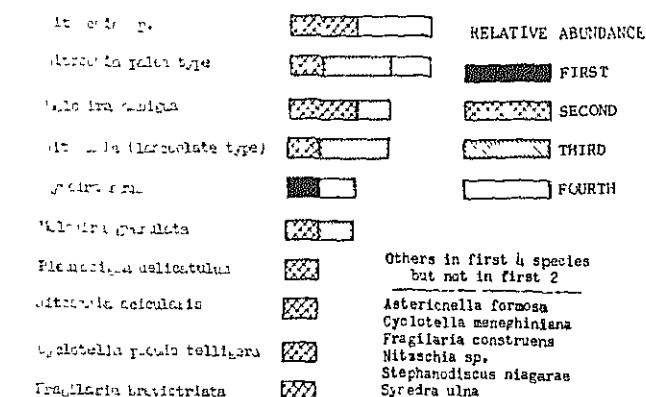
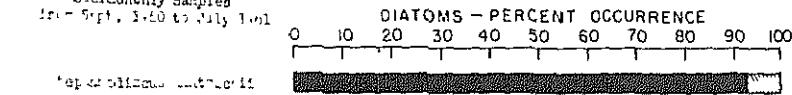
Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

Blue-green algae <i>Anacystis</i>	3
Green flagellates <i>Chlamydomonas</i>	6
Diatoms	
Centric <i>Cyclotella</i>	11
Stephanodiscus	6
Pennate	
<i>Achnanthes</i>	3
<i>Cymbella</i>	14
<i>Navicula</i>	9
<i>Synedra</i>	23



RED RIVER (NORTH)
GRAND FORKS, NORTH DAKOTA

Stratigraphic Samples
1 ft - 5 ft, 1.10 to July 1961

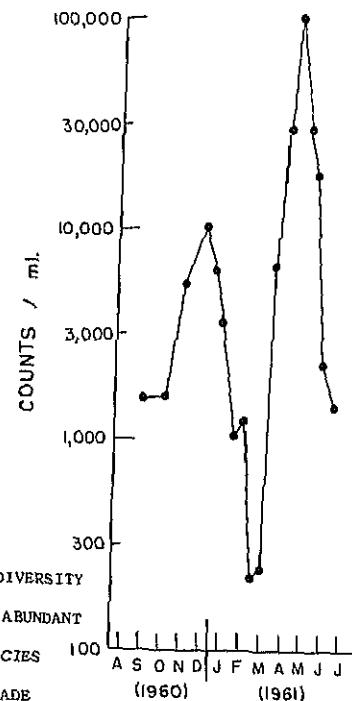


DIATOMS - SPECIES DIVERSITY

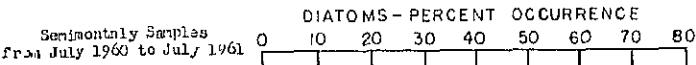
■ FIRST 4 MOST ABUNDANT
□ ALL OTHER SPECIES
■ NO ANALYSIS MADE

TOTAL LIVE PHYTOPLANKTON COUNTS

Months	Average count/ml.
June-Sept.	1,798
Oct.-Jan.	13,221
Feb.-May	24,015



RED RIVER (SOUTH)
ALEXANDRIA, LOUISIANA



Cyclotella reneghiniana

Diploneis smithii

Melosira ambigua

Synedra ulna

Stephanodiscus astracanus
var. minutula

Coscinodiscus rothii

Synedra acus

Melosira granulata

Others in first 4 species
but not in first 2

Amphipora sp.

Eunotia sp.

Nitzschia scicularis

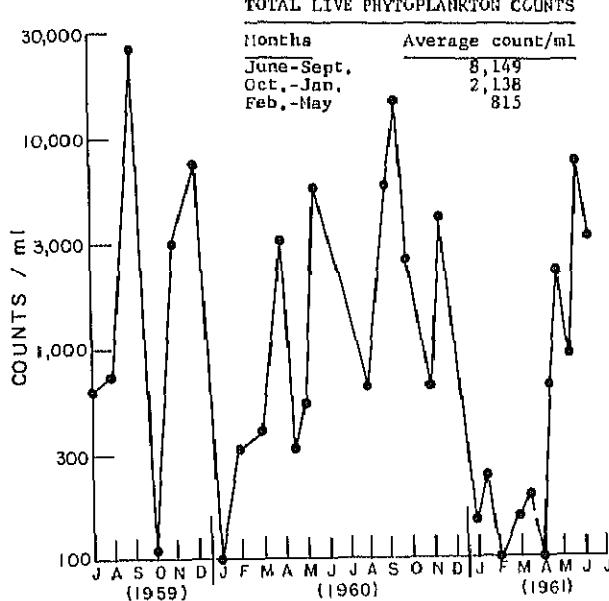
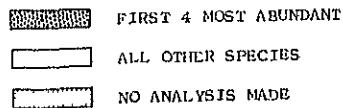
Opephora sp.

Stephanodiscus hantzschii

Stephanodiscus

1960
JULY

DIATOMS - SPECIES DIVERSITY



ZOOPLANKTON

Samples analyzed 17
July 1960 to July 1961

Samples with
Average count
Animals per liter
per sample

RELATIVE ABUNDANCE

FIRST

SECOND

THIRD

FOURTH

Rotifers:	13	48.8
Keratella	3	43.0
Polyarthra	3	1.5
Brachionus	1	0
Synchaeta	0	0
Others	9	6.3

Crustacea:	0	0
Nauplii	1	0
Copepods	1	0
Cladocera	0	0

Nematodes	1	
Other invertebrate metazoans	0	

MOST ABUNDANT
GENERA OF ALGAE

Percent frequency of counts
150 per ml, or more
From May 1959 to May 1961

Blue-green algae	
Agmenellum	16
Anabaena	13
Anacyclis	19
Arthospira	3
Oscillatoria	13
Phormidium	6
Spirulina	3

Green algae	
Acetabularia	16
Chlorococcum	3
Crucigenia	3
Oocystis	19
Scenedesmus	10
Staurastrum	3
Tetradedrum	3

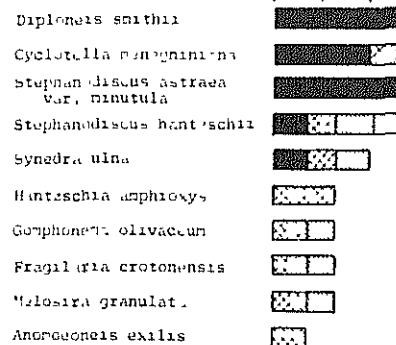
Green flagellates	
Chlamydomonas	13
Trichomonas	3

Diatoms	
Centric	
Coscinodiscus	3
Cyclotella	35
Melosira	13
Stephanodiscus	16

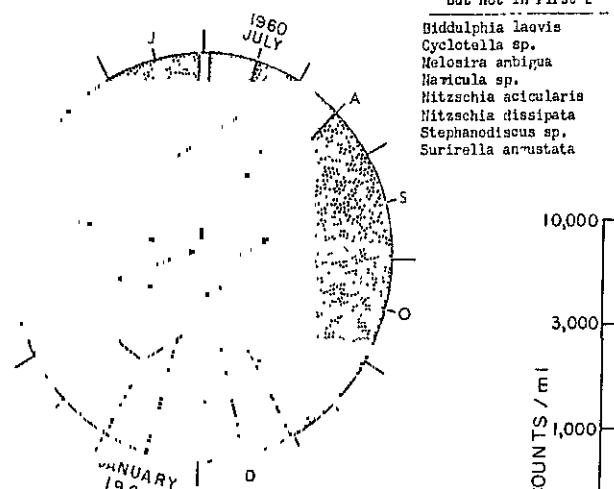
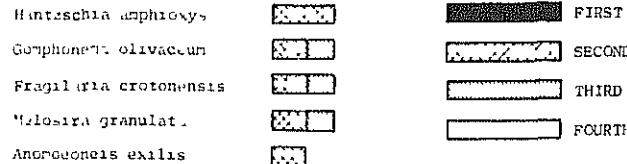
Pennate	
Cocconeis	6
Diploneis	16
Navicula	6
Mitella	16
Synedra	29

RED RIVER (SOUTH)
INDEX, TEXAS

Bi-monthly Samples
from July 1960 to July 1961

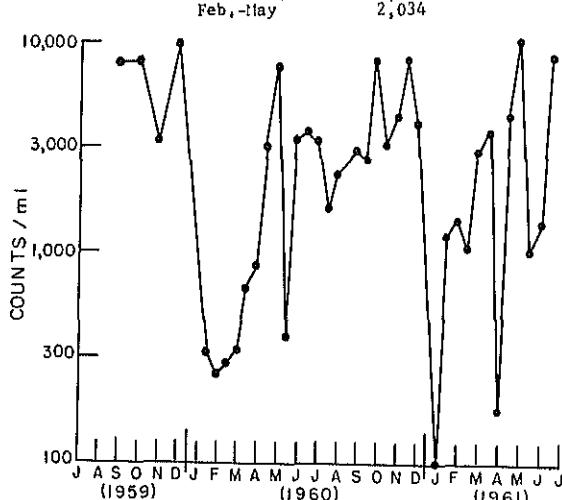


RELATIVE ABUNDANCE



DIATOMS - SPECIES DIVERSITY

■ FIRST 4 MOST ABUNDANT
■ ALL OTHER SPECIES
■ NO ANALYSIS MADE



ZOOPLANKTON

Samples analyzed 23
July 1960 to July 1961

	Samples with Animals	Average count per liter per sample
Rotifers	11	8.0
Keratella	8	3.5
Polyarthra	5	0
Brachionus	6	1.7
Synchaeta	4	1.6
Other genera	6	1.2
Crustaceans		
nauplii	0	0
copepods	1	0
cladocerans	0	0
Nematodes		3
Other invertebrate metazoan	0	

HOST ALGAE

Percent frequency of counts
150 per ml. or more
from Sept. 1960 to July 1961

	Percent frequency of counts
Blue-green algae	
Arenellum	70
Anabaena	5
Anacyclis	20
Aphanizomenon	2
Cylindrosphaeria	2
Oscillatoria	2
Raphidiopsis	2
Green algae	
Actinastrum	5
Anistrocladum	11
Chlorococcum	5
Closterium	2
Coelastrum	8
Cruicigenia	11
Dictyosphaerium	2
Lagerheimia	1
Coryctis	45
Scenedesmus	37
Tetradium	8
Tetrastrum	2

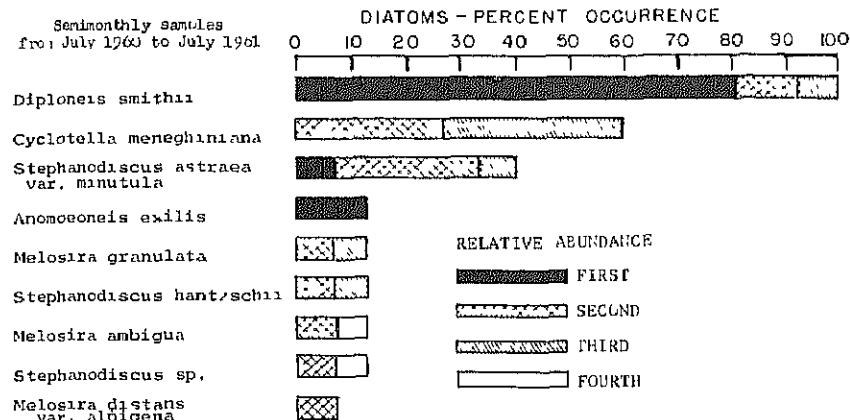
	Percent frequency of counts
Green flagellates	
Chlamydomonas	31
Flagella	5
Tachyomonas	11

	Percent frequency of counts
Other pigmented flagellates	
Chromulina	5

	Percent frequency of counts
Diatoms	
Centric	
Cyclotella	34
Melosira	5
Ranunculus	2
Stephanodiscus	70

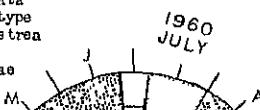
RED RIVER (SOUTH)
DENISON, TEXAS

Semimonthly samples
from July 1960 to July 1961

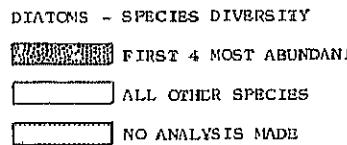


Others in first 4 species
but not in first 2

Chaetoceros sp.
Coscinodiscus rothii
Nitzschia dissipata
Nitzschia palea type
Stephanodiscus astraea
Synedra ulna
Synedra vancheriae



JANUARY
1961



ZOOPLANKTON

Samples analyzed 22
July 1960 to July 1961

Samples with
Animals Average count
per liter
per sample

Rotifers	12	6
Keratella	8	1
Polyarthra	1	0
Brachionus	3	0
Synchaeta	3	2
Others	7	3

Cladocera	9	1
Nauplii	8	2
Copepods	11	2

Other invertebrate metazoans	0	
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TOTAL LIVE PHYTOPLANKTON COUNTS

Months	Average counts/ml
June-Sept.	358
Oct.-Jan.,	1,844
Feb.-May	860

M O S T A B U N D A N T
G E N E R A O F A L G A E

Percent frequency of counts
150 per ml. or more
From May 1957 to May 1961

Blue-green algae	
Anabaena	3
Anacystis	8
Oscillatoria	3

Green algae	
Crucigenia	11
Oocystis	37
Tetrastrum	3

Green flagellates	
Chlamydomonas	18
Phacus	3
Trachelomonas	3

Diatoms	
Centric	
Coscinodiscus	3
Cyclotella	16
Melosira	3
Stephanodiscus	5

Pennate	
Cocconeis	5
Diplotheis	29
Synedra	5

RIO GRANDE
BROWNSVILLE, TEXAS

Seasonal samples
from Jul. 1959 to July 1961



Diploneis smithii
Stephanodiscus astraeanus
Cyclotella reneghiniana

Surirella striatula

Amphiprora sp.

Synedra acus

Amphiprora paludosa

Synedra ulna

Nitzschia palea type

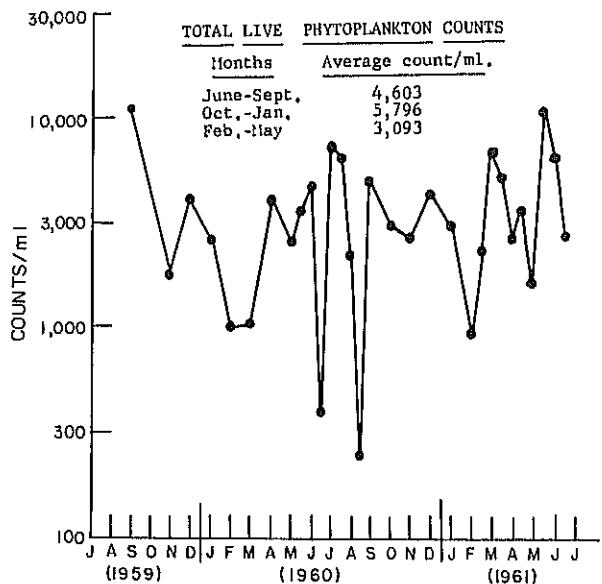
Anomooneis exilis

Nitzschia sp.

Melosira ambigua

1960
JULY

JANUARY 1961
DIATOMS - SPECIES DIVERSITY
FIRST 4 MOST ABUNDANT
ALL OTHER SPECIES
NO ANALYSIS MADE



M O S T A B U N D A N T
G E N E R A O F A L G A E

Percent frequency of counts

150 per ml. or more

From Sept. 1959 to May 1961

Blue-green algae

Agmenellum 28
Anacystis 21

Green algae

Ankistrodesmus 32
Chlorococcum 4
Cosmarium 4
Crucigenia 4
Nannochloris 4
Oocystis 20
Scenedesmus 52
Sphaerocystis 4
Tetradesmus 8

Green flagellates

Chlamydomonas 12
Frachelomonas 8

Diatoms

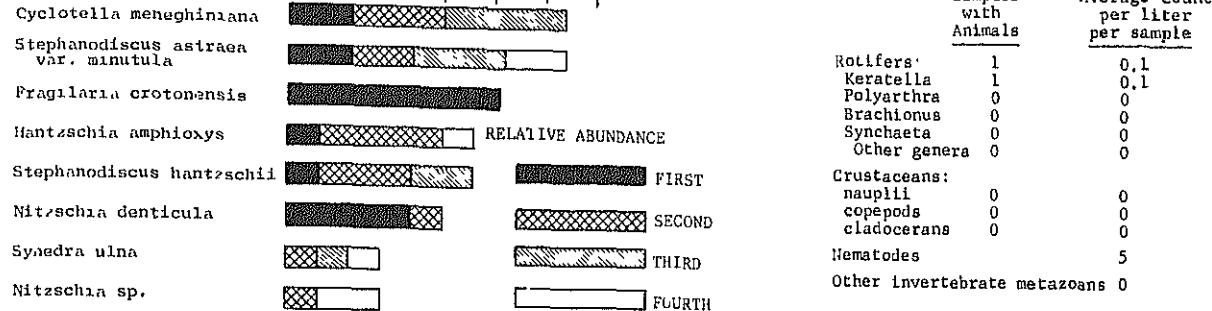
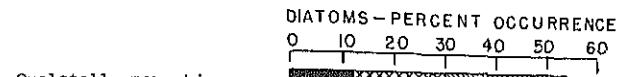
Centric
Cyclotella 28
Stephanodiscus 20

Pennate

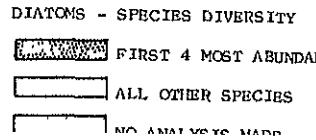
Amphipleura 4
Amphiprora 10
Amphora 4
Anomooneis 4
Cocconeis 12
Diploneis 32
Fragilaria 12
Navicula 36
Nitzschia 44
Pleurosigma 4
Surirella 12
Synedra 68

RIO GRANDE,
LAREDO, TEXAS

Sedimentaly Samples
from July 1960 to July 1961



JANUARY 1961



ZOOPLANKTON

Samples analyzed 18
July 1960 to July 1961

	Samples with Animals	Average count per liter per sample
Rotifers	1	0.1
Keratella	1	0.1
Polyarthra	0	0
Brachionus	0	0
Synchaeta	0	0
Other genera	0	0
Crustaceans:		
nauplii	0	0
copepods	0	0
cladocerans	0	0
Nematodes	5	
Other invertebrate metazoa	0	

MOST ABUNDANT GENERA OF ALGAE

Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

Blue-green algae	
Agumenellum	3
Anacyclis	3
Oscillatoria	3

Green algae	
Ankistrodesmus	11
chlorella-type	3
Closterium	6
Dictyosphaerium	3
Gloedocystis	3
Oocystis	3
Scenedesmus	17

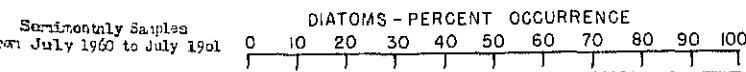
Green flagellates	
Chlamydomonas	6
Other pigmented flagellates	

Diatoms	
Centric	
Cyclotella	36
Stephanodiscus	33

Pennate	
Cocconeis	6
Cymbella	3
Fragilaria	17
Navicula	22
Nitzschia	22
Pleurosigma	3
Synedra	39

RIO GRANDE
EL PASO, TEXAS

Sediment samples
from July 1960 to July 1961



Caloneis amphibiaena

Biddulphia laevis

Amphiprora paludosus

Navicula canalis

Gomphonema olivaceum

Others in first 4 species
but not in first 2

Amphiprora alata

Diatoms vulgaris

Navicula hungarica

Navicula sp.

Nitzschia lanceolatae group

Nitzschia sigma

Nitzschia sp.

Stephanodiscus hantzschii

Syndra ulna

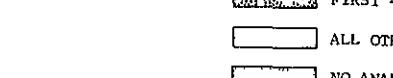
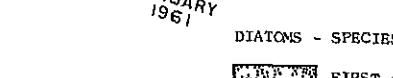
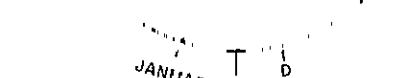
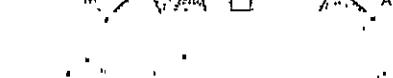
FIRST

SECOND

THIRD

FOURTH

JULY



DIATOMS - SPECIES DIVERSITY

■ FIRST 4 MOST ABUNDANT

■ ALL OTHER SPECIES

■ NO ANALYSIS MADE

ZOOPLANKTON

Samples analyzed 10
July 1960 to July 1961

Samples with
Average count
per liter
per sample

	Samples with Animals	Average count per liter per sample
Rotifers:	2	2.1
Keratella	1	0.7
Polyarthra	0	0
Brachionus	0	0
Synchaeta	0	0
Other genera	2	1.4

	Samples with Animals	Average count per liter per sample
Crustaceans.		
nauplii	0	0
copepods	1	0.2
cladocerans	1	0.2
Nematodes		2.0
Other invertebrate metazoans	0	

MOST ABUNDANT
GENERA OF ALGAE

Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

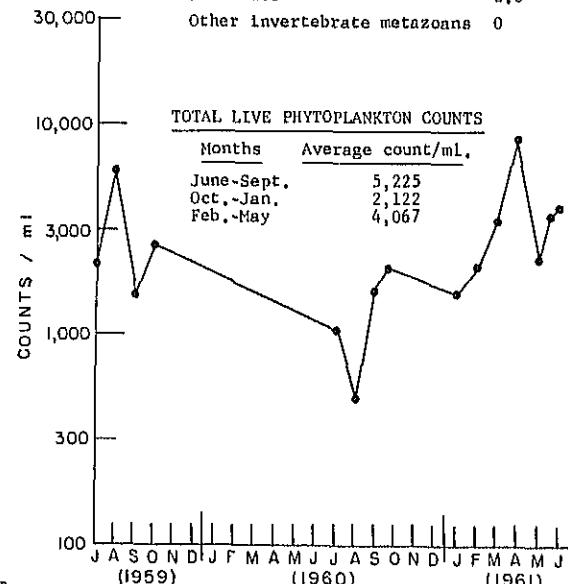
Blue-green algae
Anacystis 13

Green algae
chlorella-type 7
Chlorococcum 7
Lagerheimia 7
Scenedesmus 13

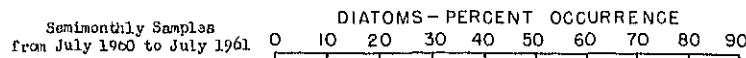
Green flagellates
Chlamydomonas 20
Euglena 26
Trachelomonas 7

Diatoms
Centric
Biddulphia 13
Cyclotilla 66
Melosira 13
Stephanodiscus 33

Pennate
Amphiprora 26
Asterionella 7
Caloneis 33
Cocconeis 13
Gomphonema 7
Navicula 33
Nitzschia 47



ST LAWRENCE RIVER
MASSENA, NEW YORK

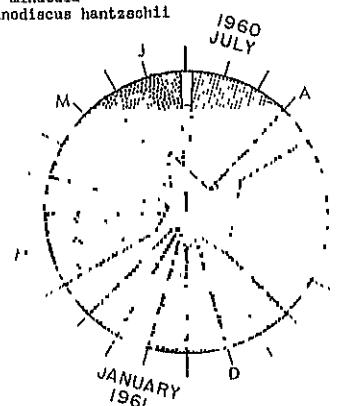


RELATIVE ABUNDANCE

Relative Abundance	Species
FIRST	Tabellaria fenestrata
SECOND	Melosira binderiana
THIRD	Fragilaria crotensis
FOURTH	Asterionella formosa

Others in first 4 species
but not in first 2

Cocconeis placenta
Cymbella ventricosa
Biatoma elongatum
Fragilaria capucina
Melosira islandica
Stephanodiscus astraea
var. minutula
Stephanodiscus hantzschii



DIATOMS - SPECIES DIVERSITY

FIRST 4 MOST ABUNDANT
ALL OTHER SPECIES
NO ANALYSIS MADE

ZOOPLANKTON

Samples analyzed 16
July 1960 to July 1961

Samples with Animals	Average count per liter per sample
Rotifers.	16.0
Keratella	7.3
Polyarthra	0.8
Brachionus	1.1
Synchaeta	0.6
Other genera	10.8

Crustaceans:	
nauplii	0.7
copepods	0.3
cladocerans	0.3
Nematodes	1.
Other invertebrate metazoans	0

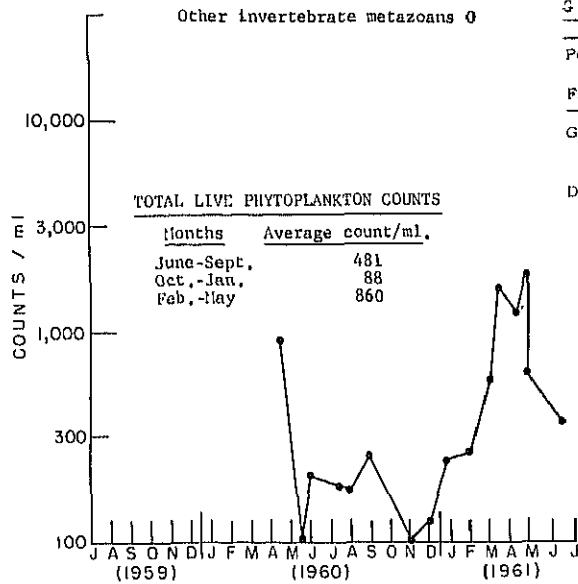
MOST ABUNDANT
GENERA OF ALGAE

Percent frequency of counts
150 per ml. or more
From April 1960 to August 1961

Green algae
Ankistrodesmus 10

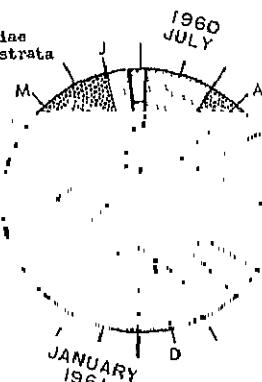
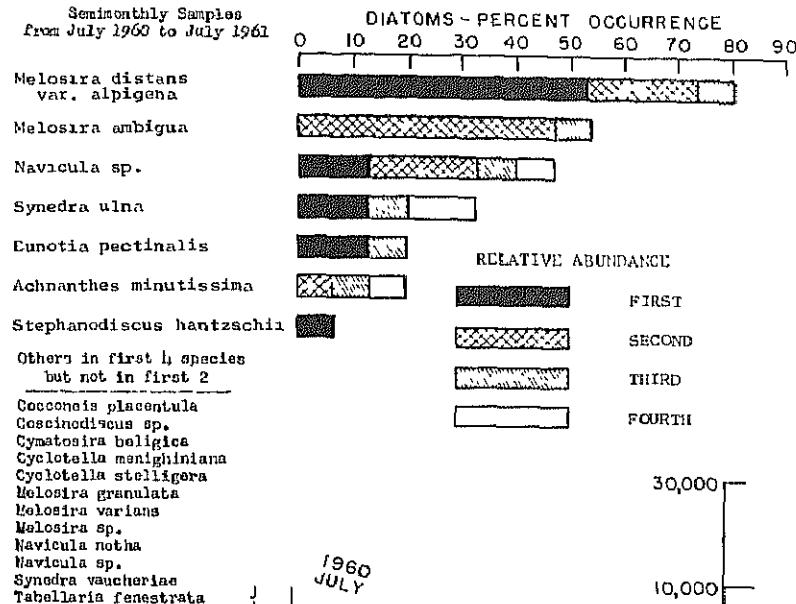
Diatoms
Centric
Melosira 21
Stephanodiscus 31

Pennate
Asterionella 10
Fragilaria 5
Tabellaria 15



SAVANNAH RIVER
NORTH AUGUSTA, SOUTH CAROLINA

Semimonthly Samples
from July 1960 to July 1961



DIATOMS - SPECIES DIVERSITY

■ FIRST 4 MOST ABUNDANT

□ ALL OTHER SPECIES

▨ NO ANALYSIS MADE

ZOOPLANKTON

Samples analyzed 15
July 1960 to July 1961

	Samples with Animals	Average count per liter per sample
Rotifers.	6	2.0
Keratella	4	1.0
Polyarthra	4	1.0
Brachionus	0	0
Synchaeta	0	0
Crustaceans:		
nauplii	3	0.4
copepods	2	0.2
cladocerans	0	0
Nematodes		0
Other invertebrate metazoans	0	0

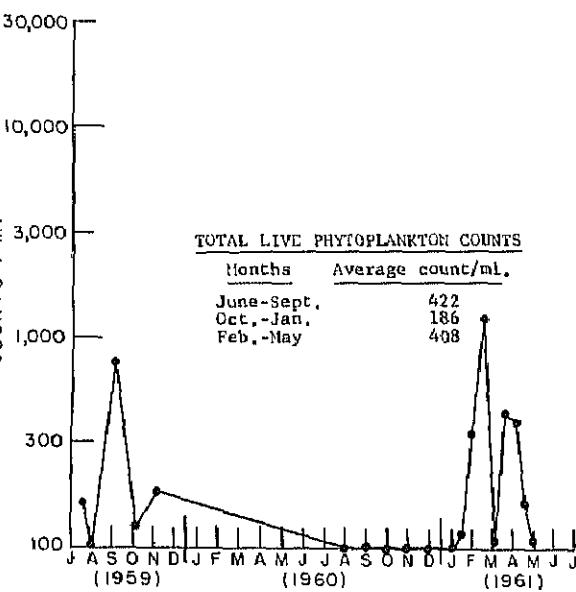
MOST ABUNDANT GENERA OF ALGAE

Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

Blue-green algae	Anacystis	4
Diatoms		
Centric		
Cyclotella		9
Pennate		
Synedra		9

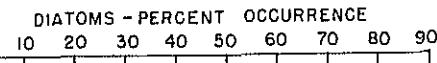
TOTAL LIVE PHYTOPLANKTON COUNTS

Months	Average count/ml.
June-Sept.	422
Oct.-Jan.	186
Feb.-May	408

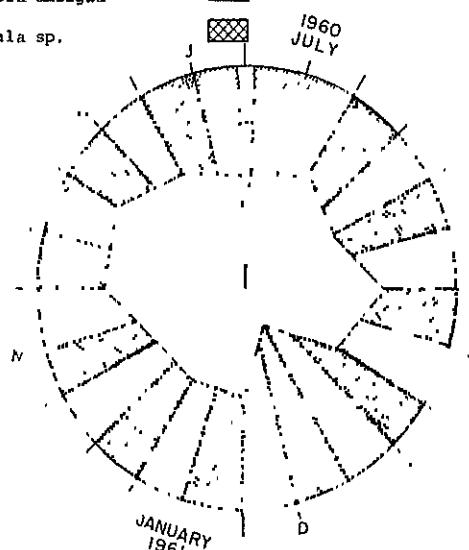


SCHUYLKILL RIVER
PHILADELPHIA, PENNSYLVANIA

Semimonthly Samples
from July 1960 to July 1961



RELATIVE ABUNDANCE



DIATOMS - SPECIES DIVERSITY

■ FIRST 4 MOST ABUNDANT

□ ALL OTHER SPECIES

ZOOPLANKTON

Samples analyzed 13
July 1960 to July 1961

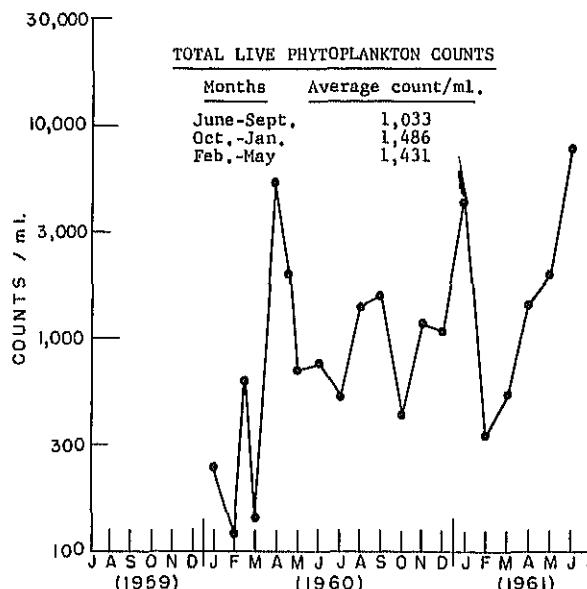
Samples with Animals	Average count per liter per sample
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Rotifers:	9	13.0
Keratella	2	0.5
Polyarthra	0	0
Brachionus	1	0.2
Synchaeta	1	0.1
Other genera	6	12.2

Crustaceans:		
nauplii	2	2.0
copepods	2	1.0
cladocerans	4	2.1
Nematodes		8.0
Other invertebrate metazoans	0	

TOTAL LIVE PHYTOPLANKTON COUNTS

Months	Average count/ml.
June-Sept.	1,033
Oct.-Jan.	1,486
Feb.-May	1,431



MOST ABUNDANT
GENERA OF ALGAE

Percent frequency of counts
150 per ml. or more
From January 1960 to May 1961

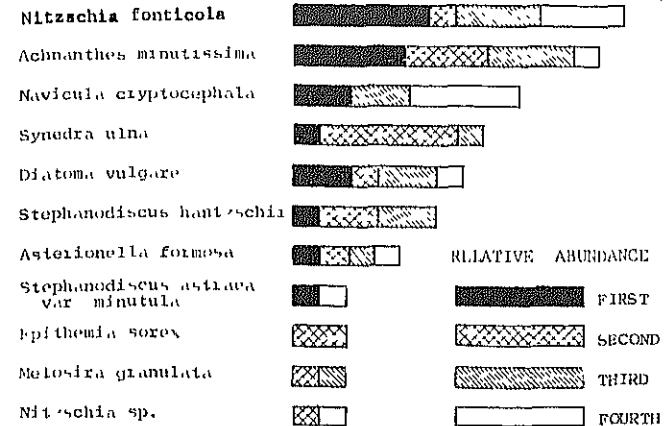
Green algae
Scenedesmus 11

Diatoms
Centric
Cyclotella 16
Melosira 5
Stephanodiscus 22

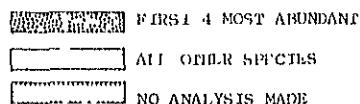
Pennate
Achnanthes 5
Diatoma 11
Gomphonema 5
Navicula 22
Nitzschia 33
Surirella 11
Synedra 33

SNAKE RIVER
WAWAWAI, WASHINGTON

Semimonthly Samples
from July 1960 to July 1961



DIATOMS - SPECIES DIVERSITY



ZOOPLANKTON

Samples analyzed 21
July 1960 to July 1961

	Samples with Animals	Average count per liter per sample
Rotifers	14	4.7
Keratella	10	2.0
Polynartha	2	0.5
Brachionus	4	0
Synchaeta	4	0
Other genera	7	2.2
Crustaceans		
nauplii	1	0
copepods	0	0
cladocerans	0	0
Nematodes		1
Other invertebrate metazoans	0	

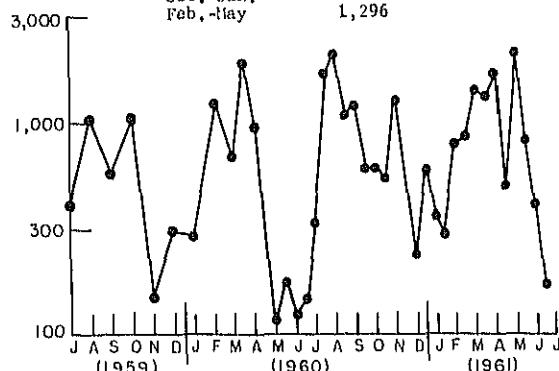
MOST ABUNDANT
GENERA OF ALGAL

Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

Green flagellates	
Chlamydomonas	3
Diatoms	
Centric	
Cyclotella	16
Malosira	8
Stephanodiscus	22
Pennate	
Achnanthes	11
Asterionella	8
Cymbella	1
Diatoma	8
Gomphonema	3
Navicula	24
Nitzschia	19
Synedra	30

TOTAL LIVE PHYTOPLANKTON COUNTS

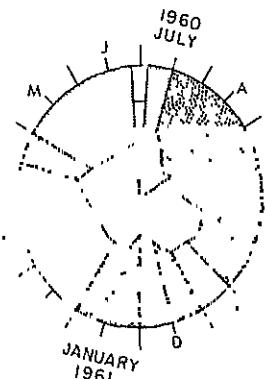
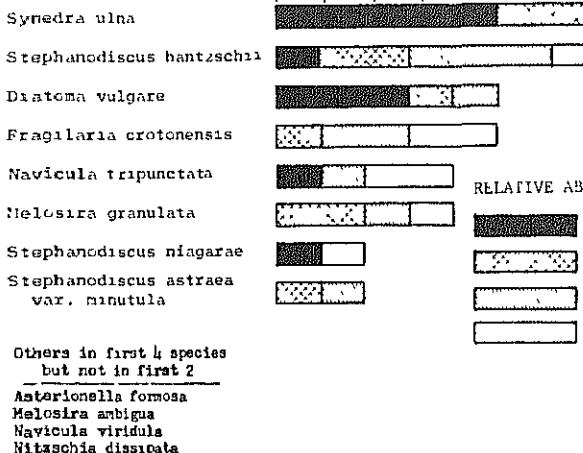
Months	Average count/ml.
June-Sept.	1,067
Oct.-Jan.	536
Feb.-May	1,296



SNAKE RIVER
WEISER, IDAHO

Sediment samples
from July 1960 to July 1961

DIATOMS - PERCENT OCCURRENCE



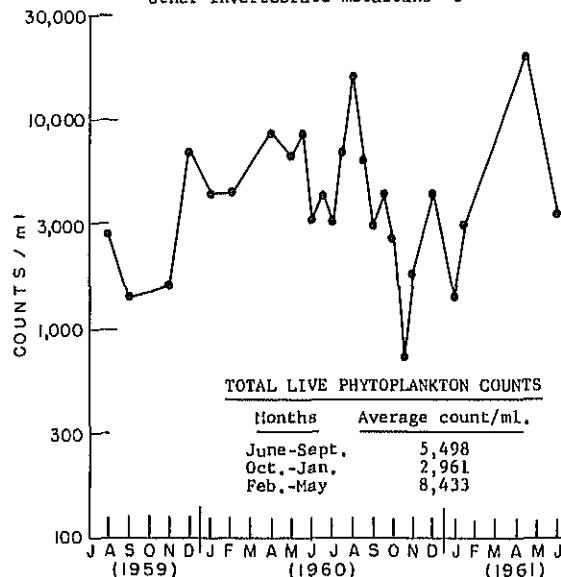
DIATOMS - SPECIES DIVERSITY

FIRST 4 MOST ABUNDANT
ALL OTHER SPECIES
NO ANALYSIS MADE

ZOOPLANKTON

Samples analyzed 13
July 1960 to July 1961

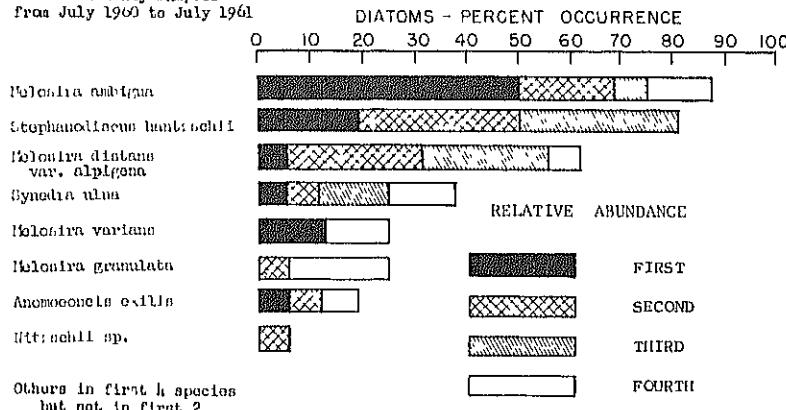
	Samples with Animals	Average count per liter per sample	MOST ABUNDANT GENERA OF ALGAE
Rotifers	12	18.8	Percent frequency of counts 150 per ml or more
Keratella	9	10.9	From May 1959 to May 1961
Polyarthra	5	1.8	
Brachionus	8	1.0	Blue-green algae
Synchaeta	4	1.8	Anacystis 4
Other genera	10	16.6	Oscillatoria 4
Crustaceans			Green algae
nauplii	2	0.5	Micractinium 4
copepods	2	0	Scenedesmus 7
cladocerans	2	0	
Nematodes		1	Green flagellates
Other invertebrate metazoans	0		Chlamydomonas 22
			Euglena 4



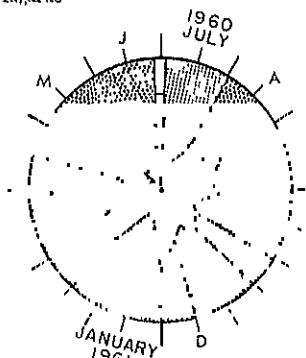
Diatoms	
Centric	
Biddulphia	4
Cyclotella	52
Melosira	30
Stephanodiscus	63
Pennate	
Achnanthes	11
Asterionella	7
Cocconeis	14
Cymatopleura	4
Cymbella	7
Diatoma	30
Fragilaria	37
Gomphonema	4
Navicula	63
Nitzschia	44
Synedra	85
Tabellaria	4

TENNESSEE RIVER
CHATTANOOGA, TENNESSEE

Semimonthly Samples
from July 1960 to July 1961



Achnanthos minutissima
Atrurionella formosa
Cocconeis placentula
Cyclotella pseudostellaria
Fragilaria crotonensis
Hietschia holstica
Stephanodiscus niagarae
Meloneira sp.



DIATOMS - SPECIES DIVERSITY

- FIRST 4 MOST ABUNDANT
- ALL OTHER SPECIES
- NO ANALYSIS MADE

ZOOPLANKTON

Samples analyzed 22
July 1960 to July 1961

Samples with Animals	Average count per liter per sample
Rotifers.	18
Keratella	15
Polyarthra	9
Brachionus	4
Synchaeta	7
Other genera 11	3.0
Crustaceans,	
nauplii	3
copepods	2
cladocerans	2
Nematodes	2
Other invertebrate metazoans	0

MOST ABUNDANT
GENERA OF ALGAE

Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

Green algae
Scenedesmus 2

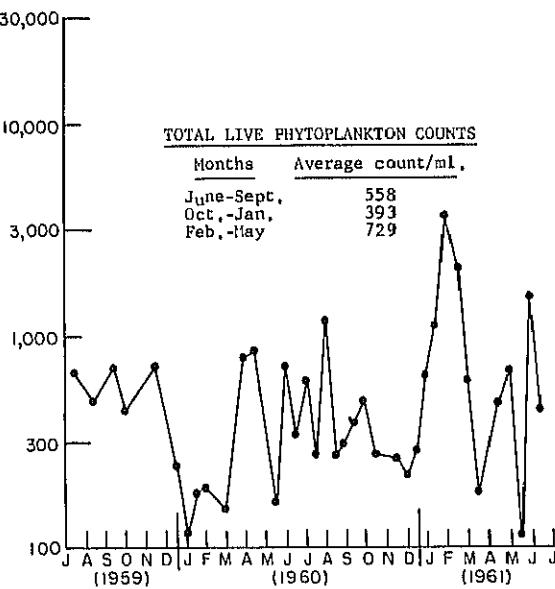
Diatoms
Centric
Cyclotella 2
Velosira 25
Stephanodiscus 18

Pennate
Asterionella 2
Fragilaria 2
Synedra 7

TOTAL LIVE PHYTOPLANKTON COUNTS

Months Average count/ml.

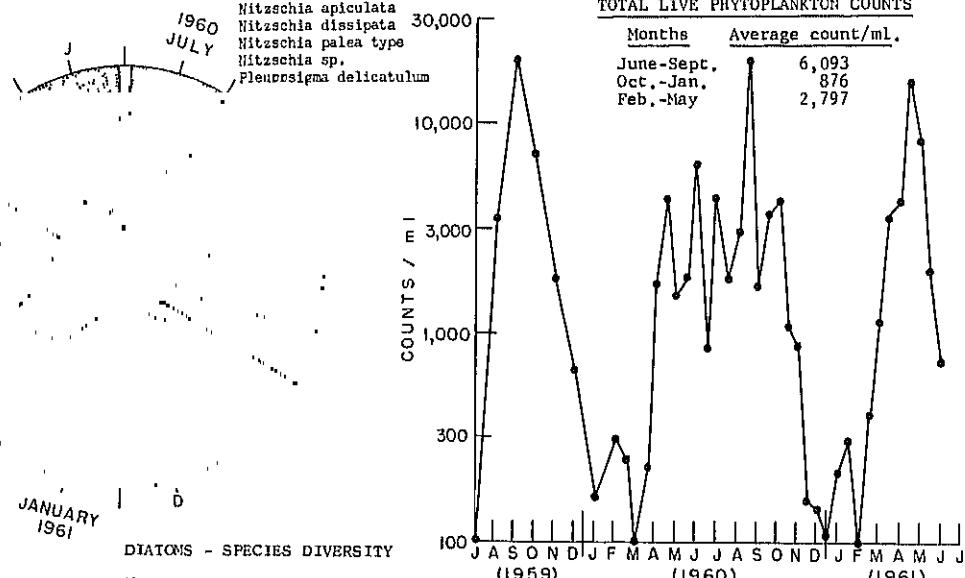
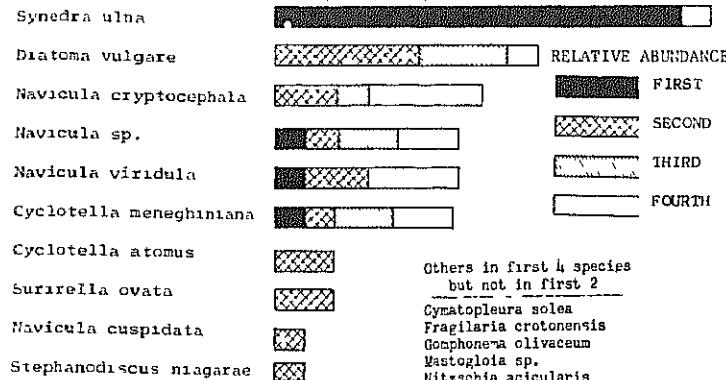
Months	Average count/ml.
June-Sept.	558
Oct.-Jan.	393
Feb.-May	729



YELLOWSTONE RIVER
SIDNEY, MONTANA

Environmentally Sampled
From July 1960 to July 1961

DIATOMS - PERCENT OCCURRENCE



DIATOMS - SPECIES DIVERSITY

FIRST 4 MOST ABUNDANT

ALL OTHER SPECIES

NO ANALYSIS MADE

ZOOPLANKTON

Samples analyzed 22
July 1960 to July 1961
Samples with Average count
Animals per liter
per sample

Rotifers:	5	0.8
Keratella	2	0.2
Polyarthra	1	0
Brachionus	0	0
Synchaeta	1	0.1
Other genera	3	0.5

MOST ABUNDANT
GENERAL ALGAE

Percent frequency of counts
150 per ml. or more
From May 1959 to May 1961

Nematodes	2.
Other invertebrate metazoans	0

Blue-green algae
Anacystis 8
Gomphosphaeria 3

TOTAL LIVE PHYTOPLANKTON COUNTS

Months	Average count/ml.
June-Sept.	6,093
Oct.-Jan.	876
Feb.-May	2,797

Green algae	
Actinostrium	5
Ankistrodesmus	11
Gloeocystis	3
Oocystis	5
Scenedesmus	18
Tetradesmus	3

Green flagellates	
Chlamydomonas	8
Trachelomonas	5

Diatoms	
Centric	
Cyclotella	26
Stephanodiscus	18

Pennate	
Caloneis	3
Cocconeis	3
Cymbella	11
Diatoma	13
Epithemia	3
Fragilaria	16
Gomphonema	8
Navicula	53
Nitzschia	34
Surirella	11
Synedra	55